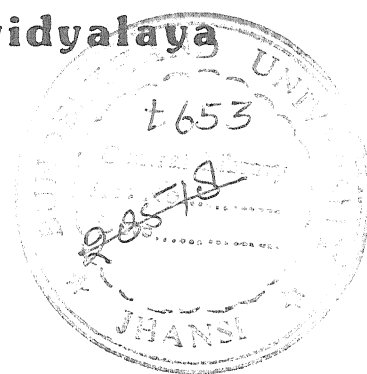


A STUDY OF TRICHOMES AND THEIR TAXONOMIC SIGNIFICANCE
IN
VERBENACEAE AND LAMIACEAE

THESIS
SUBMITTED FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY IN BOTANY
FACULTY OF SCIENCES

Bundelkhand Vishwavidyalaya
JHANSI.

1989



BY

MADAN MOHAN PANDEY
LECTURER IN BOTANY
Bipin Bihari College, Jhansi.

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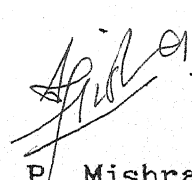
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Dr. D.P. Mishra
M.Sc., Ph.D.
Taxonomy Lab.,
Department of Botany
Bipin Bihari College
Jhansi - 284 001 INDIA

SUPERVISOR'S CERTIFICATE

It is herewith Certified that the thesis entitled " A STUDY OF TRICHOMES AND THEIR TAXONOMIC SIGNIFICANCE IN VERBENACEAE AND LAMIACEAE" being submitted for the award of Ph. D. Degree in BOTANY is a record of bonafide investigations carried out by Mr. M. M. Pandey, Lecturer, Bipin Bihari College, Jhansi. He has worked for the period required under the University Ordinance No. 7.

It is also Certified that the aforesaid subject was duly approved by the Research Degree Committee (Botany) of Bundelkhand University, Jhansi, vide letter No. B.U./Res./86/3915-17 Dated 28/10/1986, and that with the exception of supervision and guidance received from the undersigned, this thesis embodies candidate's own unaided work and his original contribution which has not previously formed the basis for the award of any Degree or Diploma etc., elsewhere.


(Dr. D. P. Mishra)

ACKNOWLEDGEMENTS

I feel great pleasure in expressing my deep sense of gratitude, indebtedness and heartiest thanks to Dr. D.P.MISHRA, Department of Botany, Bipin Bihari College, Jhansi, for his worthy guidance, timely suggestions and keen interest, throughout the tenure of present investigations.

I express my thanks to Dr. S.C.Schrotri, Principal, Bipin Bihari College, Jhansi, for his moral encouragement, inspiration and kind permission to carry out the research work.

I gratefully acknowledge the encouragement and help received from Dr. T.R.Sahu, Reader, Department of Botany, Dr. Hari Singh Gaur Vishvavidyalaya, Sagar (M.P.).

I am equally grateful to Dr. O.P.Mishra, Survey Officer, R.R.I. (Ay.), Gwalior, who helped me a lot in plant collection and identification.

I am thankful to Dr. Nautiyal, Prof. & Head, Department of Botany, & Dr. B.K.Verma, Reader, Department of Botany, and Shri S.K.Dixit, Allahabad University, Allahabad, and Dr. Bashir Ahmad, Reader, Department of Botany, Saifia College, Bhopal, for

their sincere advice and kind help in identification of plants.

I gratefully acknowledge the help rendered directly or indirectly in one or the other way by my Seniors and colleagues Dr.R.K.Agarwal, Dr.J.P.Tiwari, Prof.R.P.Khandelwal, Dr.V.I.Sharma, Dr.M.C.Kanchan, Dr.S.R.Gupta, Dr.V.P.Varshney, Dr.R.C.Gupta, Dr.J.P.Tripathi, Dr.M.Z.Siddique, Dr. A.K.Shrivastava, Dr.O.P.Yadav, Dr.Rudrakant Srivastava, Prof.Sunil K. Saxena, Prof.R.B.Sharma and Prof.S.K.Dubey.

I thankfully acknowledge all those pioneer Workers and Scholars, upon whose work I have freely drawn and whose names are beyond the scope of this brief acknowledgment.

I offer my thanks to Dr. S.N.Pandey, M.O., R.R.I.(Ay.), Jhansi, Dr.V.K.Gupta, M.O., Jhansi, Shri G.S.Singh, Shri.A.K.Mishra, Shri.S.N.Srivastava, Shri.Mahesh Chandra, C.R.Jhansi, and Shri.Santosh K.Sharma, Datia, for helping me from various corners during research period.

I am extremely happy in expressing my special thanks to Mahesh Sharma, Cheif Executive, & Mr. B.M.Pandey, Incharge, Gurdex, New Delhi, for the help rendered

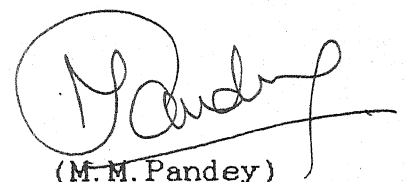
during the final shape of this thesis.

I am also thankful to Shri. J.P. Agarwal, F.C.A., Jhansi, Shri. Akhilesh Yadav and Shri. P.K. Agarwal, Director, Institute of Electronics, Computer Education Division, Jhansi, for Computerisation of the thesis.

I thank to Mr. Sadhu Ram & Shri R.G. Sharma for the assistance given in the Lab. during research.

Lastly from all corners of my heart I offer my gratitude to my parents, childrens and in particular to KUSUM, my wife, who has smiling embrassed the obvious sufferings and she has always been a source of inspiration to me during the course of this work.

Place : Jhansi.



(M.M. Pandey)

Date : 13.12.1989

C O N T E N T S



Page No.

	SUPERVISOR'S CERTIFICATE.	
	ACKNOWLEDGEMENT.	
CHAPTER I	INTRODUCTION AND REVIEW OF LITERATURE.	..... 1 - 25
CHAPTER II	MATERIALS AND METHODS	..... 26 - 33
CHAPTER III	STUDY OF TRICHOMES IN VERBENACEAE.	
	A. STRUCTURE OF TRICHOMES.	..... 34 - 131
	B. OBSERVATION & DISCUSSION.	..... 132 - 153
CHAPTER IV	STUDY OF TRICHOMES IN LAMIACEAE.	
	A. STRUCTURE OF TRICHOMES.	..... 154 - 296
	B. OBSERVATION & DISCUSSION.	..... 297 - 320
CHAPTER V	GENERAL DISCUSSION.	..... 321 - 336
CHAPTER VI	SUMMARY AND CONCLUSION	..... 337 - 346
	APPENDIX - I	..... 347 - 348
	APPENDIX - II	..... 349 - 350
	BIBLIOGRAPHY	..... 351 - 376

CHAPTER I

INTRODUCTION AND REVIEW OF LITERATURE.

CHAPTER - I

INTRODUCTION & REVIEW OF LITERATURE

It has long been recognized that the study of the histology of the epidermal appendages of leaf is an aid to the recognition of species and to their classification. Angiosperms show diverse epidermal characters which were recognised by Prat (1948) into three categories Viz, Stomata, Epidermal cells and Hairs and often correlated with taxonomic delimitations. The use of epidermal appendages in taxonomy has been well recognized. (Metcalfe & Chalk 1950).

Plant hairs are the most important component of the plant epidermis and have attracted great attention of descriptive and experimental botanist. Weiss (1867) & De-Bary (1884) initially defined: trichomes are Unicellular or Multicellular structures which originate from epidermal cells and develop on the surface of various organs. In Netolitzky's (1932) opinion such definition should in addition include

the function of trichomes (absorption, secretion, storing etc.). Cowan (1950) adopted the term "Trichome" from Greek, meaning " a hairy covering ". Trichomes or plant hairs are most useful amongst all the anatomical features for systematic comparisons of Angiosperms. Solereder (1908) in his "Systematic Anatomy of the Dicotyledons" writes; "The systematic value of the hairy covering is very great..... This is because of their wide occurrence, variety in forms, ease of preparation for study and the close relation of their variation patterns to the taxonomic system (Carlquist 1961).

Trichomes might have attracted the attention of botanists from the early days. Linnaeus (1735) distinguished the trichome as a subsidiary organ along with stipules, bracts, spines, thorns, and tendrils of the plants called the "fulcra". Jung in his "Isogoge Phytoscopia" (of Sachs, 1890 P.61) has defined trichome on a scientific basis for the first time. According to him trichomes are the structure borne by the upper part of the plants and are of secondary rank as compared to the stem, leaf, flower and fruits. The term trichome is used in a very broad

sense to designate collectively all diversified Unicellular and Multicellular appendages that develop from epidermal cells. But Netolitzky (1932) has shown that the basal portion of many Multicellular trichomes is derived partly from epidermis and partly from hypodermal cells. According to De Bary (1884) such structures are called emergences. This clearly shows that demarcation between trichome and emergence can not easily be marked out. For clearcut understanding of these structures, a comparative ontogenetic study of large number of plants of different groups is essential. Ramayya (1964) in the light of the ontogenetic and comparative morphological evidences of several Angiosperms concluded that, trichomes are distinct from the emergences. Levin (1973) defined the term of trichome as a hair like appendages extending from the epidermis of aerial tissues.

Trichomes which are very common on almost all the Angiospermic plants, in a multitude of forms, size, and density, furnish a rich field for morphogenetic investigations. But the interest in trichomes has long been quite superficial in earlier days. The consideration of trichome character for

taxonomic delimitation came into existence by Hanstein as back as 1868, who has figured Glandular hairs on the leaf bud of Azalea indica.L. Hairs of this species were further studied, described and illustrated by Rauter (1870). Glandular trichomes have been the subject of various workers such as the early one of the Martinet (1872), Fenner (1904), and Solereder & Meyer (1933). In recent past Carlquist (1958, 1959a, & 1959b) studied the structure and ontogeny of Glandular trichomes of Medinaceae, Calydenia and Holocarpa. Recently excellent studies have been carried out by many workers on the development, structure and morphology of Glandular trichomes of different types in different families such as Luttge(1971), Hammond & Mahlberg (1973, 1977, 1978) Unzelman & Healey 1974, Oleson 1975, Akers et al., (1978), Turner et al., (1978), Tiwari (1978), Vermeer & Peterson (1979a, 1979b) Kreitner & Sorensen (1979a), Werker & Fann (1981, 1982), Franceschi & Giaquinta (1983), Vincent, Franceschi & Giaquinta (1983), Kelsey (1984), Ascensao & Pais (1987), Oliveira et al., (1988).

A number of excellent studies have attested the

systematic importance of trichomes, not only at generic level but also to evaluate the interrelationships between the families. Heintzelman & Howard (1948) showed that types of trichome, relative number of types and their organographic distribution in genus, provide a good criteria within Icacinaceae. Cowan (1950) have emphasized that trichomes are excellent criteria for subgeneric and specific level in Rhododendron. Similarly forms and distribution of trichomes were correlated with specific and subgeneric distinctions in Nicotiana by Goodspeed (1954).

In the recent years the use of trichomes for taxonomic delimitations have also been stressed by many workers in various groups. Sporne (1956), Mathur (1961), Stace (1965), Inamdar (1967), Ramayya & Rajgopal (1971), Patel & Inamdar (1972), Raghuvanshi and Singh (1972), Ahmed (1972), Jain & Singh (1973), Shah & Kothari (1973), Ramayya & Prabhakar (1973), Martinus (1974), Singh et al., (1974), Unzelman & Healey (1974), Jain & Singh (1974b), Guedes (1975), Knoboch et al., (1975), Oleson (1975), Rollins & Banerjee (1975), Ramayya & Rao (1976), Ahmad (1976), Dayanandan & Kaufman (1976), Rao &

Ramayya (1977), Gupta & Murty (1977), Fahn & Shimony (1977), Sahu (1977, 1982, 1984, 1985), Larsten (1977), Tiwari (1978), Siddiqui et al., (1978), Kreitner & Sorensen (1979), Cutler (1979), Franklin (1979), Dave et al., (1979), Hardin (1979), Dehgan (1980), Edmonds (1982), Prabhakar et al., (1984), Mishra (1984, 1985), werker et al., (1985), Trivedi & Chakravorty (1986), Garnall (1986), Fahn (1986), Andrejewska & Swietoslawski (1987), Chung & Shin (1987), Mathew & Shiveranjan (1987), Bashir (1988), Rao & Saibaba (1988), Kumar (1988).

Besides the vegetative parts, trichomes of floral parts have also been studied in Cleome viscosa of Capparidaceae (Ramayya & Gopalcharulu 1968), Ipomoea of Convolvulaceae (Inamdar 1968), Capsicum of Solanaceae (Raghuvanshi & Singh 1972), Utricularia of Lantabulariaceae (Hasmi & Siddique 1974), Chrysanthemum morifolium of Compositae (Vermeer & Peterson 1979), Corchorus tridens of Tiliaceae (Gour 1979), Crotalaria of Papilionaceae (Gupta 1980), Canavalia gladiata of Papilionaceae (Shah & Mohandas 1982).

Extensive work has been done on different aspects of trichomes. They occur in a multitude of forms and sizes. Although they have been used widely for taxonomic purposes, their adaptive significance has been all, but ignored by the evolutionist and ecologist. It is clear that trichomes plays a role in plant defense, especially with regard to phytophagous insects. In numerous species there is a negative correlation between trichome density, insect feeding and oviposition responses and the nutrition of larvae (Levin 1973). A relationship between pubescence and pest resistance was established by Poose (1929) and Poose & Smith (1931), who reported that the extent of injury is related to the amount and type of pubescence. The glabrous varieties, being the site of greater infestation & oviposition, was observed much damaged than the pubescent varieties. Johnson (1953) reported that larva or adult of Aphis craccivora may be permanently impaled or die by hooked trichomes of the French bean (Phaseolus vulgaris). The relationship between the pubescence and varietal resistance to leaf hoppers was corroborated by Wolfen-burger & Sleesman (1963). In some group of plants protection against large mammals

is achieved by the presence of stinging trichomes (Levin 1973). In this regards detailed study of morphology and toxicology of stinging hairs have been done by many workers in various plants Viz., Jatropha (De Condolle 1832, Habertlandt 1914). Tragia volubilis (Cruger 1855, Stahl 1888). Urtica dioica & U. urens (Wicke 1861, Rauter 1872). Tragia cannabina (Rao & Sundraraj 1951), Tragia saxicola and Urtica dioica (Thurston 1969, 1974).

As trichomes are often characterstic to particular species, their usefulness to analysis of hybrids were also considered by Canon (1909), Rollins (1944), and Goodspeed (1954). The Demonstration of hybrid origin of vernonia taxa by comparison of the trichome comlements of the two parental species and their hybrid progeny was given by Hunter & Austin (1967). Bernard & Singh (1969) studied the inheritance of pubescence in Soyabeans.

Sharma & Tyree (1973) have studied the role of trichomes in relations with enviornmental pollution. They have suggested that trichomes can be used as an indicators of enviornmental pollution. Wegoner (1975) found that the trichome density and length is changed

in highly polluted area. Sharma & Butler (1975) have also studied the relationship in between environment and trichome along with other epidermal characters.

Under well preserved conditions, the trichomes provide an aid to the study of the fossils. Trichomes along with stomata and cuticle have rendered much help in the identification and reconstruction of several fossil forms. Such as Lagenaria oldhamia (Scott 1923). Morphological characters of trichomes are often employed in the identification of diverse plant materials, such as foliar and cauline parts (Bower 1926), flowers and fruits (Chitaley 1954).

Considerable interest seem to have been created in studying the plants trichomes leading to accumulation of much data in Angiosperms, during the last century. The naming of trichome types and their classification has attracted an attention of several workers from an early period of plant anatomical studies.

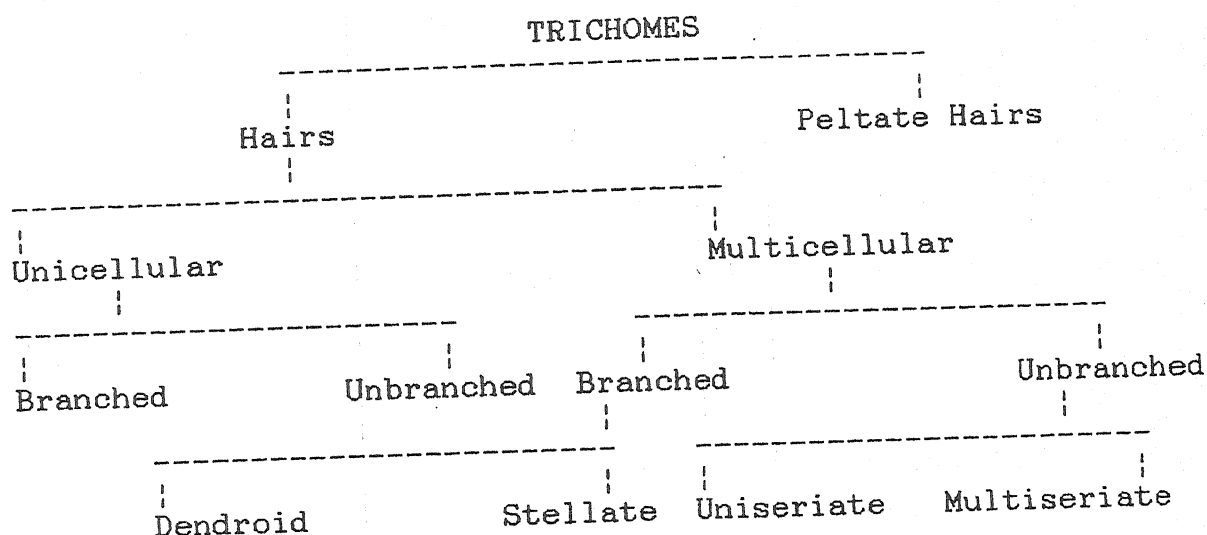
Classification of trichomes based on their structure has been attempted by many workers. Wiess (1867) was the first who has divided plant hairs into 3 major groups Viz., (a) all the constituent cells of

hairs are of same kind (b) all the constituent cells are not of the same kind, (c) cells provided with a secretion (c.f. Upholf 1962, P. 11). Rauter in 1872 proposed probably the first ever classification of trichomes, based on ontogeny, and he divided it into two groups :- (a) those derived from epidermal cells and (b) other have their origin in epidermal as well as hypodermal cells (emergences). Debary (1884) distinguished 6 categories of various form of hairs. They are (I) Bladders or Papillose, (II) Hairs, (III) Scales, (IV) Shaggy hairs, (V) Warts and (VI) Prickles. According to him bladders are isodiametric, usually unicellular bodies, whereas, thread like bodies, are unicellular or consisting of a row of cells, simple or branched and filiform, conical or capitate in form. Solereder (1908) recognised two main categories of trichomes, i.e. Cottony hairs and the Glandular hairs. Netolitzky (1932) in his "Die Pflazenhaare" for the first time has reviewed the work done upto that time on trichomes and their classification. He has suggested two main categories of classification:-

(a) - Ontogenetic Classification and

(b) - Structural Classification.

Foster (1949) Classified the trichomes into different morphological categories:-



Metcalf & Chalk (1950) classified the trichomes into two main groups i.e. Non glandular and Glandular hairs. Cowan (1950) studied trichomes of Rhododendron leaf and reported total 25 forms of trichomes under three main categories i.e. (a) Papillae, (b) Scales, (c) Hairs. Uphof (1962) perhaps for the first time gave a comprehensive account of various type of trichomes. They are classified into various morphological categories:-

1. Non glandular trichomes:

(a) Unicellular trichomes

(b) Multicellular trichomes.

- (1) Uniseriate : vasiculate, capitate.
- (2) Multiseriate.
- (3) Branched : ramulose, tufted, stellate.
- (4) Peltate.

2. Glandular trichomes:

- (1) Stigmatic papillae.
- (2) Multicellular.
- (3) Peltate glandular.
- (4) Shaggy glands e.g. Tabernaemontana.
- (5) Stringing hairs e.g. Urtica.
- (6) Salt glands e.g. Distichalis spicata.

Ramayya (1972) proposed a classification of trichomes based on ontogeny of trichome. He has divided vegetative trichomes of Angiosperms in 5 phyletic system : (a) Unicellular, (b) Uniseriate filiform, (c) Uniseriate macroform, (d) m-Multiseriate and (e) p - Multiseriate. In recent years a good number of research papers have been published which deal with trichome and their systematic classification. Some noteworthy ones are those of Hummel & Staesche (1962), Ramayya (1962), Inamdar & Patel (1973), Alley Kutty & Inamdar (1978),

Leelavathi & Ramayya (1983), Julion & Estella (1987).

Cowan (1950) the usefulness of hairs as taxonomic characters is diminished by the fact that no standard terminology exists for them due to many reasons. Some of them are as follow: (a) single term can not apply for compound structure of hairs, as the multitude of hair features required numerous descriptive terms just as do other plant parts e.g. Leaf is described in several criteria viz., colour, size, texture, shape, ray orientation etc. (b) often a continuous range of complexity of hairs from Unicellular, or Uniseriate to Multiseriate and/or multirayed complex types occur in a single species, (c) use of relatively few terms to describe even many recent hair types in a rather general and inconsistent manner, (d) lack of standard terminology of trichomes. Further the delimitation of trichome types of Angiosperms is problematic due to frequent intergradation of one type to the other and due to lack of knowledge about total type of trichomes. The main reason behind it is that no standard nomenclature is so far in use and the data available in the literature is very often confusing.

Cowan (1950) used precise terminology for the first time during the studies of trichomes in Rhododendron. Ramayya (1962) has given the Bi to polymonial names to the trichomes. Roe (1971) suggested the terminology which are to long (e.g. sessil porrect stellate hairs with long central ray etc.) to communicate and inconvenient for comparision. Further they are not indicative to the general structural pattern on which they are built. First and most concised publication on the hair terminology is that of Payne (1978).

A considerable interest seems to have been created in studying the plant trichomes leading to accumulation of sufficient data in many orders and families of Angiosperms. For examples : Compositae (Ramayya 1962), Combretaceae (Stale 1965), Oleaceae (Inamdar 1967), Goodeniaceae (Corolin 1971), Aizoaceae (Ramayya & Ramagopal 1971), Gentianales (Patel & Inamdar 1972), Solanaceae (Ahmad 1972), Loganiaceae (Bendre 1973), Polymoniales (Inamdar & Patel 1973), Gesneriaceae (Sahasrabudha & Stace 1974), Berberidaceae (Singh et al., 1974 b), Rosaceae (Jain & Singh 1974 a), Cucurbitaceae (Inamdar & Gangadhara 1975), Scrophulariaceae (Datta & Deb

1975), Malvaceae (Ramayya & Rao 1976), Capparidaceae (Gupta & Murthy 1977), Euphorbiaceae (Inamdar & Gangadhara 1977), Acanthaleae (Ahmad 1978), Capparidaceae (Alley Kutty & Inamdar 1978), Palms (Ghose 1979), Ranales (Alley Kutty 1980), Combretaceae (Stace 1980), Euphorbiaceae (Dehgan 1980), Helianthoideae (Sahu 1982 b), Mimosoideae (Leelavathi & Ramayya 1982), Vernoniaceae & Senecionoideae (Sahu 1983 a), Caesalpinoideae (Leelavathi & Ramayya 1983 a), Papilionoideae (Leelavathi & Ramayya 1983 b), Chenopodiaceae (Carolin 1983), Mimosaceae (Shah & Rangayya 1983), Malvales (Inamdar et al 1983), Euphorbiaceae (Mishra 1984), Tiliaceae (Rao & Rammaya 1987), cucurbitaceae (Julian & Estella 1987), Scrophulariaceae (Sarathambal 1987) Stecruiliaceae (Rao 1987), Araceae (French 1987), Scrophulariaceae (Bashir 1988).

Although trichomes vary in structure within larger and smaller groups of plants, they are remarkably uniform and may be used for taxonomic purposes. (Cowan 1950). In view of this Uphof & Hummel (1962) have emphasized the great need for detail study of trichomes on different organs in

various plant groups to establish homology.

Taxonomic and phylogenetic importance of trichome evidence is widely recognized. According to sporne (1956) Glandular Character of leaves is very well correlated with many groups. (King & Robinson 1970) have used trichome character along with other epidermal features for determining generic circumscriptions in composite. In all such attempts, the qualitative characters of trichomes are taken into account. But in order to understand the value of trichome evidences in classification and phylogeny, it is necessary that trichome types and trichome systems are also considred.

Besides the taxonomic utility, trichomes have been proved to be of immense value in pharmacognostic studies. Along with the other characters, they have been extensively used in the identification of drugs (Small 1919; Youngken 1954). Thorton & Nakamura (1972) described the nairs of the member of Verbenaceae along with 90 other plant as being of forensic interest in the indetification of illicit marihuana.

Verbenaceae is a large family comprising of

about 75 genera 3000 species (willis 1966); 75 genera & 1300 species (Bailey 1949); 98 genera & 2614 species (Lawreances 1951); 80 genera & 800 species (Rendle 1955). The taxa of this family are distributed mostly in tropical and subtropical region, although Verbena extend into temperate regions of the New World, and a few species in a colder parts of the Old World, (Lawrence 1951). In India the family is represented by 23 genera (Hooker 19885) 21 genera & 125 species. (Singh & Jain 1981), occuring mostly in Southern and Western India and the tropical and subtropical Himalayas.

The plant show a great variation in habit, they are mostly shurb or under shurb, climbers, sprawling, twining or climbing by means of thorns, spines as in Lantana, Clerodendron, Vitex. Avicennia is mangroove shurb inhabiting tropical shores in both hemispheres. Tectona grandis grows in forest of Burma, M. P. and Assam, the timber is one of the best for all wood works and is durable. Genera with species, idegenous to this country include Verbena, Phyla, and Callicarpa, extending into the cooler regions and Durenta, Lantana, and Stachytarpheta in the Southern

and Southern extremities, Verbena, Lippia, & Lantana represent the family in Western part of the country (Lawrence 1951).

The Lamiaceae is another large family comprising of about 200 genera & 3200 species (Lawrence 1951); Willis (1966) mentioned 180 genera & 3500 species, Rendle (1959) consider 170 genera & 3000 species. In India this family is represented by 55 genera (Hooker 1985). Plants of this family are cosmopolitan distribution, but they are mainly distributed in the temperate and Warm zones of the World. Several endemic genera occur in Australia e.g. Prostanthera, Hyptis, Ocimum etc. spread over tropical to subtropical region. Many temperate genera such as Plectranthus, Calamintha, Salvia, etc. are found to grow in temperate Himalayas.

Most of the plants are either annual or perennial herb inhabiting the temperate regions. In warmer climates, the plants have a tendency to become shrubby in nature. Trees are however rare. Many are xerophytes with extremely reduced leaves. A few are marshy plants or climbers. Leucas aspera, Ocimum sanctum etc. are herbs, Salvia aegyptiaca is

profusely branched under shrub. Ocimum gratissimum is profusely branched shrub. Species of Leucocephalum (India) and a few species of Hyptis (Brazil) are trees. Species of Mentha is a marshy plant, some species of Scutellaria (America) is a climbing plant, although climbing habit is extremely rare in this family. Some plants possess sucker e.g. Mentha arvensis.

Bentham & Hooker (1962-1983) placed these families i.e, Verbenaceae & Lamiaceae in the order Lamiales-Bicarpellatae Gamopetalae-Dicotylendons. The verbena family is generally accepted as belonging within the "Tubiflorae" and of close affinity to the Labiatae. Although Bessey (1915) separated the Labiatae & Verbenaceae on the basis of corolla zygomorphy, and gynoecial characters as a distinct order. Benson (1957), Takhtajan (1969), Cronquist (1968, 1981), Soo (1975), Dehlgren (1980) placed these two families in order Lamiales. But Hallier (1905), Rendle (1925), Wettstein (1935) followed the Englerian's view that these families belong to the "Tubiflorae". Hutchinson 1926 did likewise at first but latter 1948, restricted the Lamiales to the Labiatae & segregated the Verbenaceae as the

Verbenales and considered these two as unrelated (the former is in Herbaceae & the latter is in Lignosae). According to him " In dividing the Dicotyledons into two main phyla Lignosae & Herbaceae, I had constantly in mind two families Verbenaceae & Lamiaceae (Labiatae) and the criticism which would no doubt follow in due course because of them being widely separated. My reply to such is that I see little, if any real affinity between the two families, what resemblance or relationship may I ask is there between that magnificent timber tree, Teak Teactona grandis Linn., a Vitex, or a Clerodendron on the one hand and on the other hand a Dead-Nettle Lamium album Linn., a Coleus, or a Salvia ? None whatever in my judgement, such as it is and I am content to leave it to posterity to consider it. Therefore, in this phylogenetic system the basic family for verbenaceae is Ehretiaceae and the basic for Lamiaceae is surely Boraginaceae".

Recently in 1980 a new version of Takhtajan's system of classification (1969) has been published in Botanical Review, in which he separated the family Verbe¹aceae from Lamiales and placed it in the next

order scrophulariales. The Systematic position of these families as ascribed by different taxonomist is as under :

BENTHAM & HOOKER (1862-1883)		ENGLER & PRANTL (1887-1899)	
=====		=====	
Div. II	: Dicotyledons	Class 2	: Dictyoyledoneae
Class II	: Gamopetalae	Sub-class B	: Metachlamydeae
Series III	: Bicarpellatae	Series 6	: Tubiflorae
Order 7	: Lamiales	Sub-series C	: Verbenineae
Family	: Verbenaceae	Family	: Verbenaceae
	Labiatae		Labiatae

HALLIER (1905)		RENDLE (1925)	
=====		=====	
	Dicotyledoneae		Dicotyledons
Group IV	: Ochnigenes	Grade C	: Sympetalae
Order 28	: Tubiflorae	Group B	: Tetracyclidae
Family	: Verbenaceae	a	: Superae
	Labiatae	Order 4	: Tubiflorae
		Sub-order 3	: Verbenineae
		Family	: Verbenaceae
			Labiatae

HUTCHINSON (1948)			
=====			
Div. I	: Lignosae	Div. II	: Herbaceae
Order 54	: Verbenales	Order 82	: Lamiales
Family	: Verbenaceae	Family	: Labiatae

BENSON (1957)		TAKHTAJAN (1969)	
=====		=====	
Sub-class	: Dicotyledons	Div.	: Magnoliophyta
Group II	: Corolliflorae	Class	: Magnoliatae
Order 28	: Lamiales	Sub-class G	: Asterideae
Family	: Verbenaceae	Super-order XIV	: Lamianae
	Lamiaceae	Order 71	: Lamiales
		Family	: Verbenaceae
			Labiatae

TAKHATAJAN (1980)

=====

Div. : Magnoliophyta
 Class : Magnoliopsida
 Sub-class G : Asterideae
 Super-order : Lamianae
 Order 67 : Lamiales
 Family : Lamiaceae

Order 68 : Scrophulariales
 Family : Verbenaceae

DEHLGREN (1980)

=====

Class : Magnoliopsida
 Sub-class : Magnoliidae
 Super-order: Lamiiflorae
 Order : Lamiales
 Family : Verbenaceae
 Lamiaceae

CRONQUIST (1981)

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Div. : Magnoliophyta
 Class : Magnoliopsida
 Sub-class VI : Asterideae
 Order 3 : Lamiales
 Family : Verbenaceae
 Lamiaceae

Much has been written about Verbenaceae pertaining to its various aspects like; Taxonomy and Morphology (Junell 1934; Airy shaw 1952; EL-Gazzar 1974; Tronocoso 1980; Ahmad 1982, 1984, 1987; Bomley 1984; Methew & Shah 1984; Senders 1984_a, 1987; Fernandes 1985a, 1985b); Anatomy (Rao 1952, Bhatt et al. 1979, Ghouse et al. 1980); Cytology (Tondon & Bali 1955; Tondon & Chand 1955; Sharma & Kukhopadhyay 1963; Choudhary & Roy 1982; 1983, 1984; Bigazzi 1984; Spices 1984; Chauhan et al. ;1986; Chatha & Bir 1988); Pollen morphololgy (Erdtman 1945; Raj Bhoj 1983_{ab}, 1988); General (Srivastava & Gupta 1986).

Similarly in the *Lamiaceae* much work done on its various aspects like Embryology (Bushnell & Sturt 1936; Santha Kumari 1976; Dwivedi and Joshi 1980a,b, 1981, 1988; Dwivedi 1984, 1987); Anatomy (Stauffer 1937; Bhatti & Dunn 1962; Bhatnagar & Dunn 1963; Bech 1963; Kalambet 1981, 1984; Rudall 1981, 1981a 1982, 1986; Turner & Lersten 1983; Azizian & Cutler 1982; Dyugaeva 1986; Abu-asab & Cantino 1987; Suarez 1987); Pollen morphology (Erdtman 1945; Rudall 1980); Reproduction morphology (Dwivedi & Joshi 1987); Evolution (Santha Kumari 1982); Fungi toxic properties (Bhargava, Dixit, Dube & Tripathi 1981); Ecology & Biosystematic (Durrah 1974, Baskin & Baskin 1982; Andrew & Hutchings 1983; Baden 1987); Cytology (Morton 1962, Gill 1970, 1979, 1980, 1981; Chasanova & Kaplanbekova 1971; Mehra & Gill 1971; Singh 1978; Haque & Ghoshal 1980; Elena Rosello 1981; Pushpagadan & Sobti 1975, 1982; Sharma & Singh 1981; Singh & Sharma 1981, 1981b, 1982, 1983; Queiros 1982; Stahl 1984; Khosla & Sobti, 1984, Singh 1984, 1986; Svensen & Wigren 1984; Saggoo & Bir 1986, Kundu & Sharma 1988); Taxonomy and Morphology (Hooker 1885; Schnarf 1917; Mukherjee 1940; Murthy 1946; Hillson 1959; Wunderlich 1963; EL-Gazzar & Watson 1967,

1970a, 1970b, Jain & Jain 1973; El-Gazzar 1974; Bhattacharya 1978; Taigi 1979; Azizian 1980; Sebald 1980; Harley 1974, 1983, 1985, 1987; Cronquist 1981; Sanders 1981, 1984, ~~1987~~, Press 1982; Wood 1982; Ramamoorthy 1986; Devesa et al., 1985; Smirnova 1986; Suarez & Camba 1985; Almeida & Ribeiro 1986; Ayobangira & Ntezuruben 1987; Ramamoorthy & Lorence 1987; Al-Musawi & Ali, 1988).

The taxonomic value of trichome is of special relevance in Verbenaceae and Lamiaceae, because of their wide distribution in almost all sorts of environmental conditions. The observation about trichome structure and their organographic distribution as taxonomic marker are mostly fragmentary. Studies so far available on this field is not extensive. The work done so far on the trichome of Verbenaceae is as follows: Metcalfe & Chalk 1950; Numerical taxonomy of the Verbenaceae; A Re-Assessment (El-Gazzar 1974); Trichomes in some species of Clerodendrum. (Shah & Methew 1982); The structure, ontogeny & Organographic distribution of stomata and trichomes on the vegetative and floral organ in 4 ornamental-taxa Lantana (Shah & Methew

1982b); studies on the foliar epidermis stomatal patterns and floral trichomes in some Verbenaceae (Kaushal & Tripathi 1984). Similarly in the Lamiaceae; Metcalfe & Chalk 1950; Mathur 1961; Singh, Sharma & Jain 1974a; Dwivedi & Joshi 1977; Gupta 1978; Gupta & Bhambie 1978, 1979; Bosabalidis & Tsekos 1982a, 1982b, 1984; Bruni & Modenesi 1983, Shah & Naidu 1984; Azizian & Cutler 1985; Werker, Ravid & Putievsky 1985; Olowokudejo & Sheteolu 1988; are the workers who studied the trichome types of Lamiaceae at species and generic level. But no exhaustive work has been done on the trichome aspect at the family level.

In view of the above facts the present investigations were undertaken, which deal with detailed study of structure, organographic distribution and taxonomic significance of vegetative as well as floral trichomes of 35 species of Verbenaceae and 50 species of Lamiaceae. An attempt has also been made to justify the taxonomic affinities at trichome level in between these two closely related/unrelated families.

CHAPTER II

MATERIALS AND METHODS

CHAPTER - II

MATERIALS AND METHODS

Present study is based on 85 species belonging to 39 genera representing two families i.e. Verbenaceae & Lamiaceae (Tables I & II).

The species were collected from different parts of the country particularly from the hills of Kashmir, Dehradun, plains of North India and Bundelkhand Region. In addition to the field collection, herbarium specimens of some taxa were also procured from systematic botany branch F.R.I. Dehradun, R.R.I Gwalior, and Herbarium, Botany Department, Allahabad University, Allahabad.

The taxa collected were compared with specimens kept in the herbaria of R.R.I. Gwalior and Allahabad University, Allahabad and identified .

Trichomes were studied in the epidermal peels for their struture, type and distribution on different Plant parts (viz stem, petiole, leaves,

pedicel, inflorescence axis, bracts/bracteoles, calyx, corolla, stamens and carpels).

Epidermal peels of fresh as well as herbarium materials, were taken out for trichome study, following the method of Leelavathi and Ramayya (1975). Both vegetative and floral parts of each species were initially boiled in 5-10% of HCl (Hydrochloric acid) or HNO₃ (Nitric acid). After washing with water the materials were then boiled in 5% NaOH (Sodium hydroxide). The materials after cooling were again washed thoroughly in water to get them free from alkali. The peelings were then stained with aqueous safranin and mounted in glycerine. For storing, slides were made semipermanent by ringing the edges of cover slips with the mountant (D.P.X).

The slides were studied for trichome structure under the microscope and camera lucida diagrams of the trichomes were drawn.

The terminology used in the present study is based on that of Solereder (1908), Ramayya (1962) and Payne (1978).

Various terms used in the description of

trichome parts are briefly explained here under :

(a) FOOT

It is proximal part of the trichome lying within the epidermal surface. It is recognised into two kinds, viz.

- i) Simple : consisting of as many cells as the number of cell rows in the immediate overlying part.
- ii) Compound : consisting of cells which are more in number than the cell rows in the immediate overlying parts.

(b) BODY

It is the part of trichome lying above the foot i.e, away from the epidermal surface. It is of two categories, viz.,

- i) Differentiated : Consisting of two different parts:

- 1. Stalk - representing proximal region.
- 2. Head - representing distal region.

- ii) Undifferentiated : The body of the trichome is entire, not differentiated into stalk and head.

Key based on characters of trichomes for identification of the taxa is also prepared separately for both families. These keys are given at the end of General Discussion (Appendix 1 and 2).

TABLE - I

NAMES OF TAXA OF VERBENACEAE STUDIED FOR THEIR TRICHOMES

S.NO.	TAXA	OTU'S NO.
1.	<i>Lantana camara</i> Linn. Var. <i>aculeata</i> (L.)	1
2.	<i>L. indica</i> Roxb.	2
3.	<i>Petrea volubilis</i> Linn.	3
4.	<i>Lippia geminata</i> H.B.K.	4
5.	<i>L. nodiflora</i> Rich. in Michx. (Syn. <i>Phyla nodiflora</i> . Greene in Pittonia).	5
6.	<i>Stachytarpheta indica</i> Vahl. Enum.	6
7.	<i>Nyctanthes arbor-tristis</i> Linn. sp.	7
8.	<i>Verbena bipinnatifida</i> schau.	8
9.	<i>V. bonariensis</i> Linn.	9
10.	<i>V. officinalis</i> Linn.	10
11.	<i>Duranta plumieri</i> . Jacq. select. (syn. <i>Duranta repens</i> Linn.)	11
12.	<i>Callicapra lanata</i> Linn. (Syn. <i>C. Wallichiana</i> walp. Rep.)	12
13.	<i>C. macrophylla</i> Vahl.	13
14.	<i>C. tomentosa</i> Lamk. (Syn. <i>C. Cana</i> Linn.)	14
15.	<i>Tectona grandis</i> Linn.	15
16.	<i>Præna latifolia</i> Roxb.	16
17.	<i>P. Wightiana</i> Schauer.	17

TABLE I (Contd-----)

S.NO.	TAXA	OTU'S NO.
1.	Gmelina arborea Linn. (Syn. Premna arborea Roth.)	18
2.	G. philippensis chann.	19
3.	Vitex negundo Linn.	20
4.	V. coriacea Clarke.	21
5.	V. agnus-castus. Var. Kurz (Syn. V. trifolia Linn)	22
6.	V. Siamica Wilhains.	23
7.	Clerodendron fragrans Var. pleniflorum schauer. (syn. c.fragrans auct.)	24
8.	C. indicum (L) Kuntze.	25
9.	C. Inerme Gaertn. Fruct. (Syn. Volkameria inermis L.sp.pl.)	26
10.	C. infortunatum Gaertn.	27
11.	C. peniculatum Linn. (Syn. C. splendidum)	28
12.	C. phlomoides Linn. f. suppl.	29
13.	C. multiflorum.	30
14.	C. multizuga.	31
15.	C. serratum Linn (Moon). (Syn. Volkameria serrata (L.Mant).	32
16.	C. splendens G. Don.	33
17.	Holmskioldia sanguinea Retz.	34
18.	Caryopteris Wallichiana schauer.	35

TABLE - II

NAMES OF TAXA OF LAMIACEAE STUDIED FOR THEIR TRICHOMES

S.NO.	TAXA	OUT'S NO.
1.	<i>Ocimum basilicum</i> Linn. (Syn. <i>O. minimum</i> Burm.)	1
2.	<i>O. canum</i> Sims. (Syn. <i>O. americanum</i> Linn.)	2
3.	<i>O. gratissimum</i> Linn. (Syn. <i>O. robustum</i> Heyne)	3
4.	<i>O. sanctum</i> Linn.	4
5.	<i>O. kilimandscharicum</i> Guerke.	5
6.	<i>Orthosiphon pallidus</i> Roylems. (Syn. <i>O. Verticillatus</i> Heyne in Herb.)	6
7.	<i>O. rubicundus</i> Benth. (Syn. <i>virgatus</i> Benth., <i>Plectranthus rubicundus</i> & <i>virgatus</i> Don Prodr.)	7
8.	<i>Plectranthus coetsa</i> Ham. in Don Prodr. (Syn. <i>Ocimum coetsa</i> spreng.)	8
9.	<i>P. mollis</i> spreng. (Syn. <i>P. incanus</i> Link Enum.)	9
10.	<i>Anisochilus carnosus</i> wall. (<i>Plectranthus strobiliferus</i> Roxb.)	10
11.	<i>Hyptis suaveolens</i> Poit.	11
12.	<i>Lavandula burmanni</i> Benth. (Syn. <i>L. multifida</i> Burm)	12
13.	<i>Pogostemon parviflorus</i> Benth.	13
14.	<i>P. plectranthoides</i> Desf. In Ann. (Syn. <i>Origanum Indicum</i> Roth. Nov.)	14

TABLE II (Contd.--)

S.NO.	TAXA	OTU'S NO.
1.	<i>Colebrookia oppositifolia</i> Smith. (Syn. <i>C.ternifolia</i> Roxb.)	15
2.	<i>Elsholtzia polystachya</i> Benth.	16
3.	<i>E. strobilifera</i> Benth.	17
4.	<i>Mentha arvensis</i> Linn.	18
5.	<i>M.spicata</i> Linn.	19
6.	<i>Origanum vulgare</i> Linn. (syn. <i>O. laxiflora</i> . Royle in Hook)	20
7.	<i>Thymus serpyllum</i> Linn.	21
8.	<i>Micromeria biflora</i> Benth. (Syn. <i>Thymus biflorus</i> Ham. in wall)	22
9.	<i>M. capitellata</i> Benth.	23
10.	<i>Calamintha umbrosa</i> Benth. (Syn. <i>C. clinopodium</i> Var <i>Umbrosa</i> Hook)	24
11.	<i>Meriandra bengalensis</i> Benth. (<i>Salvia bengalensis</i> Roxb)	25
12.	<i>Salvia coccinia</i> Linn.	26
13.	<i>S. hians</i> Roylems.	27
14.	<i>S. plebeia</i> Br. Prodr. (Syn. <i>S. Parviflora</i> Roxb.)	28
15.	<i>Nepeta connata</i> Royle ex. Benth.	29
16.	<i>Nepeta hindostana</i> (Roth) Haines. (Syn. <i>Glechoma hindostana</i> , Roth; <i>N. ruderalis</i> Buch- Ham)	30
17.	<i>N. tibetica</i> Benth.	31

TABLE II (Contd.--)

S.NO.	TAXA	OTU'S NO.
1.	<i>Scutellaria grossa</i> wall.	32
2.	<i>Brunella vulgaris</i> Linn. (syn. <i>Brunella</i> Linn. & <i>Prunella</i> Linn.)	33
3.	<i>Anisomeles indica</i> linn. Kuntze. (Syn. <i>Nepeta Indica</i> Linn; <i>A. Ovata</i> R.Br.)	34
4.	<i>Lamium album</i> Linn.	35
5.	<i>Leucas urticaefolia</i> Br. Prodr. (Syn. <i>Phlomis urticaefolia</i> Vahl Symb.)	36
6.	<i>L. lanata</i> Benth in wall. (Syn. <i>L. collina</i> Dalz, <i>Marrubium mollissimum</i>)	37
7.	<i>L. nepetaefolia</i> Benth.	38
8.	<i>L. mollissima</i> wall.	39
9.	<i>L. procumbens</i> Desf.	40
10.	<i>L. biflora</i> Br. Prodr.	41
11.	<i>L. stelligera</i> wall.	42
12.	<i>L. nutans</i> spreng. (Syn. <i>Phlomis natans</i> Roth)	43
13.	<i>L. martinicensis</i> Br. Prodr.	44
14.	<i>L. cephalotus</i> Spreng.	45
15.	<i>L. aspera</i> spreng.	46
16.	<i>L. linifolia</i> spreng. (Syn. <i>L. lavandulaefolia</i> Sm. in Rees Cyclop)	47
17.	<i>Leonotis nepetaefloia</i> Br. Prodr. (Syn. <i>Phlomis nepetaefolia</i> Linn.)	48
18.	<i>Ajuga bracteosa</i> wall.	49
19.	<i>A. macrosperma</i> wall.	50

CHAPTER III

STUDY OF TRICHOMES IN VERBENACEAE.

A. STRUCTURE OF TRICHOMES.

B. OBSERVATION & DISCUSSION.

CHAPTER - III
STUDY OF TRICHOMES IN VERBENACEAE

A. STRUCTURE OF TRICHOMES

Thirty five Species belonging to fifteen genera of the Family Verbenaceae have been studied for their trichomes. Structural details of the trichomes and their distribution on various parts of the individual species are given below :-

LANTANA CAMARA

It shows eight type of trichomes. (Plate 1 Fig. 1-10).

1. **UNICELLULAR PAPILLOSE HAIR.**

Foot: Simple. Body: 1- Celled, tubular, papillose; Cell long; tip rounded; walls thin, rugose, straight; lumen wide; content translucent. Distrib: Corolla. (Fig.1)

2. **UNICELLULAR ACERATE HAIR.**

Foot: Not visible. Body: 1-celled, very long, narrow, acerate; cell narrowly elongated, base swollen; tip pointed, walls thin and smooth; lumen narrow; content opaque. Distrib.; Leaf-margin. (Fig.2).

3. UNICELLULAR ACUMINATE HAIR.

Foot: Compound, Body 1-celled, very long, acuminate; tip acuminate, walls thin, rugose; lumen narrow; content opaque. Distrib.: Stem, petiole, leaf upper surface & margin, infl. axis (Fig.3).

4. UNICELLULAR CONICAL HAIR.

Foot: Simple. Body: Entire, elongated, conical; cell, wide & tapering; tip pointed; walls thick, smooth or rugose, straight one side; lumen wide; content translucent. Distrib. : Stem. petiole, leaf, infl. axis, bract, calyx & corolla. (Fig. 4).

5. UNICELLULAR CURVED HAIR.

Foot : Compound. Body : 1-celled, entire, curved; cell long and turn aside; tip pointed, upward; walls thick or thin, rugose; lumen wide; content translucent. Distrib.: stem, petiole, leaf-lower surface, infl. axis, bract & corolla. (Fig.5).

6. UNICELLULAR HOOKED HAIR.

Foot: Compound. Body; 1-celled, hooked cell rigid, wide & long; tip obtuse; walls thick, rugose; lumen wide; content translucent. Distrib: Stem,

petiole leaf, infl. axis, bract & corolla. (Fig.6)

7. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body : Differentated ; satlk 1-celled, short, clavate-Fig. 7 or discoid-Fig.8 or much longer than head-Fig.9, Wall thin, content trnslucent; head 2 celled, oblong, arranged length wise, (Fig. 7) or 1-celled, obovate or elliptical content dense accumulated in the center - (fig.8) glandular cells more than 6, hyaline, arranged length wise in globose structure, wall thin, content dense (fig.9) Distrib: Fig.7-Stem, leaf upper surface & corolla; Fig.8 stem, petiole, infl. axis, bract & corolla; Fig.9-Stem, infl. axis bract & corolla.

8. UNISERiate GLANDULAR CAPITATE HAIR.

Foot: Simple : Body : Differentiated; stalk 3-4 celled, cells of varied length & shapes, terminal cell cup shaped & distinct, walls thin, smooth, content translucent; head large, globose, glandular cells many, arranged length wise, thin walled, content dense. Distrib: Leaf-surface, infl. axis & bract. (Fig.10).

LANTANA INDICA

There are six type of trichomes observed in this species. (Plate-1 Fig.11-17).

1. UNICELLULAR PAPILLOSE HAIR.

Foot: Simple. Body: 1-celled, long, papillose; tip obtuse; walls thin, smooth, straight; lumen wide; content translucent. Distrib: Leaf, infl. axis, bract & stamen. (Fig. 11).

2. UNICELLULAR FLAGELLATE HAIR.

Foot: Simple. Body: 1-celled, entire, cell very long and cylindrical flagellate, tip obtuse Fig.12 or cell long conical-flagellate-fig.13; walls thin, rugose; lumen wide; content translucent. Distrib.: Fig 12- Stamen, Fig.13. Petiole, leaf- upper surface & margin, infl. axis, bract, calyx, corollal stamen.

3. UNICELLULAR CONICAL HAIR.

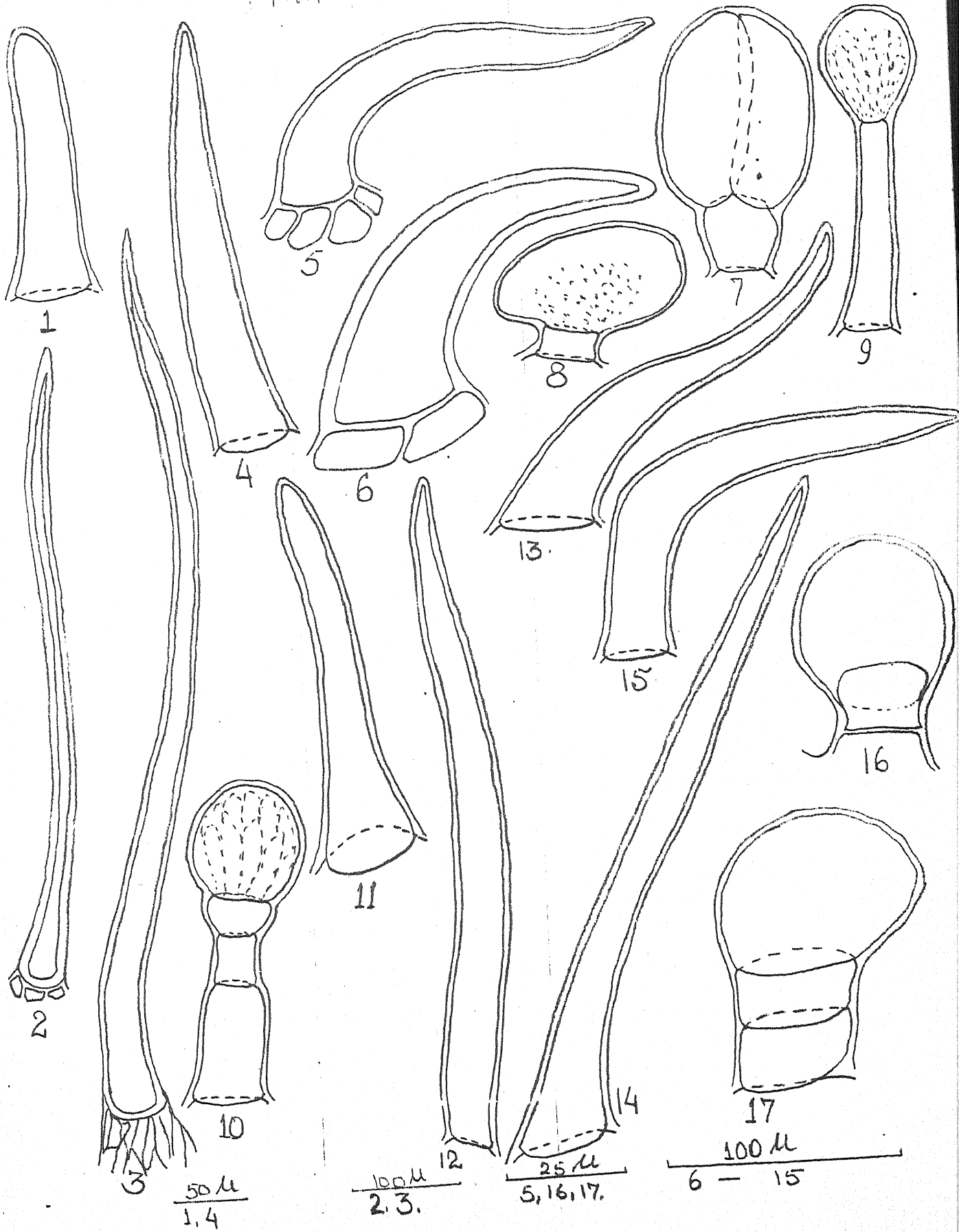
Foot: Simple. Body: 1 celled, entire, long. conical, cell wide and tapering to a pointed tip; walls thin, rugose, straight; lumen wide; content translucent. Distrib. : Stem, petiole, leaf- upper surface, infl. axis, bract, calyx & corolla (Fig.14).

Explanation of the figures of Plate 1.
Trichomes from various plant parts.

Figs. 1-10	:	<u>Lantana camara</u>
Figs. 1, 4	:	Corolla.
Figs. 2, 6	:	Leaf-margin.
Figs. 3, 7, 8	:	Stem.
Fig. 5	:	Bract.
Fig. 9	:	Infl. axis.
Fig. 10	:	Leaf lower surface.

Figs. 11-17	:	<u>Lantana indica.</u>
Figs. 11, 17	:	Leaf upper surface.
Fig. 12	:	Stamen filament.
Fig. 13	:	Leaf lower surface.
Fig. 14	:	Infl. axis.
Figs. 15, 16	:	Stem.

PLATE-1



4. UNICELLULAR HOOKED HAIR.

Foot: Simple. Body : 1 -celled, entire, hooked; cell stiff & turn aside, tip obtuse; walls thick, rugose or smooth; lumen wide; content translucent. Distrib: Stem, leaf, infl. axis, bract, calyx (Fig. 15).

5. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot; Simple. Body: Differentiated; stalk 1-celled, wider than long, discoid; head 1 celled, large, globose, wall thin, content opaque evanescent. Distrib: Stem, petiole, leaf upper surface & calyx (Fig. 16).

6. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body : Differentiated; stalk 2 celled, cells wider than long, walls thin, smooth, convex, content translucent; head 1-celled, large, irregularly globose, thin walled, content opaque. Distrib: Leaf-lower surface, infl. axis. bract, calyx, corolla & Stamen. (Fig. 17).

PETREA VOLUBILIS

It shows nine type of trichomes (Plate.2
Fig 18-28)

1. UNICELLULAR PAPILLOSE HAIR.

Foot: Simple. Body : 1-celled, long, hyaline, tubular, papillose; tip rounded; walls thin, smooth; lumen wide; content translucent. Distrib: Leaf-lower surface (Fig.18).

2. UNICELLULAR FLAGELLATE HAIR.

Foot: Compound (Fig.19) or simple (Fig.20). Body: 1-celled, very long, entire, flagellate; cell base wide or tubular; tip obtuse; walls thin, smooth, straight; lumen wide or narrow; content translucent. Distrib. : Fig: 19 calyx; Fig.20-Stem, petiole, leaf lower surface, calyx & corolla.

3. UNICELLULAR CONICAL HAIR.

Foot : Compound. Body : 1-celled, long, slightly curved, conical; tip obtuse; walls thick, smooth, lumen wide; content opaque. Distrib: calyx (Fig.21).

4. UNICELLULAR HOOKED HAIR.

Foot: Simple. Body:1-celled, arrect, hooked; cell small, base wide; tip pointed; walls thick, smooth;

lumen wide; content opaque. Distrib: Stem, leaf margin & calyx. (Fig.22).

5. BICELLULAR FILIFORM HAIR.

Foot : Compound. Body 2-celled, entire, long, filiform; cells much longer than breadth; tip obtuse; lateral walls thick, smooth & straight; cross walls thick;; lumen wide; content opaque. Distrib: Stem petiole, leaf lower surface, calyx & corolla(Fig.23).

6. UNIS^ERIATE CONICAL HAIR.

Foot: Compound. Body 3-6 celled, stiff, conical; cells of varied length; tip obtuse; lateral walls thick, smooth, straight; cross walls thick; lumen wide; content translucent. Distrib. : Stem. petiole, leaf surface (Fig.24).

7. PELTATE HAIR.

Foot: Not clearly visible. Body: Multicellular, shield-like, circular, parallel to epidermis, 1-celled in thickness, 8-10 celled in diameter; cells triangular, radiating from center, outer and lateral walls thin, entire, cutinised, hyaline, content translucent. Distrib.: Stem & leaf lower surface. (Fig.25).

8. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 2-celled, upper short, collared, lower cell prominent, longer than breadth, lateral and cross walls thin, smooth, content translucent; head 1 celled, large, capitate globose, glandular cells many, arrange length wise, wall thin, hyaline, content golden yellow. Distrib. : Stem, petiole, leaf lower surface & corolla (Fig.26).

9. UNISERIAL GLANDULAR CAPITATE HAIR.

Foot: Simple, or compound. Body: Differentiated; stalk 3-celled, basal cell much longer than rest (Fig.27) or of equal size, cubical (Fig.28) lateral and cross walls thin, smooth straight or convex, constricted at joints, content translucent; head large, globose, consisting two glandular cells, walls thin, content golden yellow. Distrib. : Fig. 27-Stem, petiole, and corolla; Fig. 28-Stem.

LIPPIA-GEMINATA

It shows seven type of trichomes-(plate 2 Fig.29-35).

1. UNICELLULAR PAPILLOSE HAIR.

Foot: Simple. Body: Entire, base wide, papillose; tip rounded; walls thin, smooth; lumen wide; content translucent, Distrib: calyx & corolla. (Fig.29).

2. UNICELLULAR FLAGELLATE HAIR.

Foot: Simple. Body: Long. narrow, flagellate; tip pointed; walls thin, smooth or rugose; lumen wide; content translucent. Distrib: petiole, leaf, bract, calyx & corolla (Fig. 30).

3. UNICELLULAR CONICAL HAIR.

Foot: Compound. Body: Entire, elongated, erect, conical; tip pointed; walls thin, smooth or rugose; lumen wide; content translucent. Distrib.: Stem, petiole, leaf surface, bract & corolla. (Fig. 31).

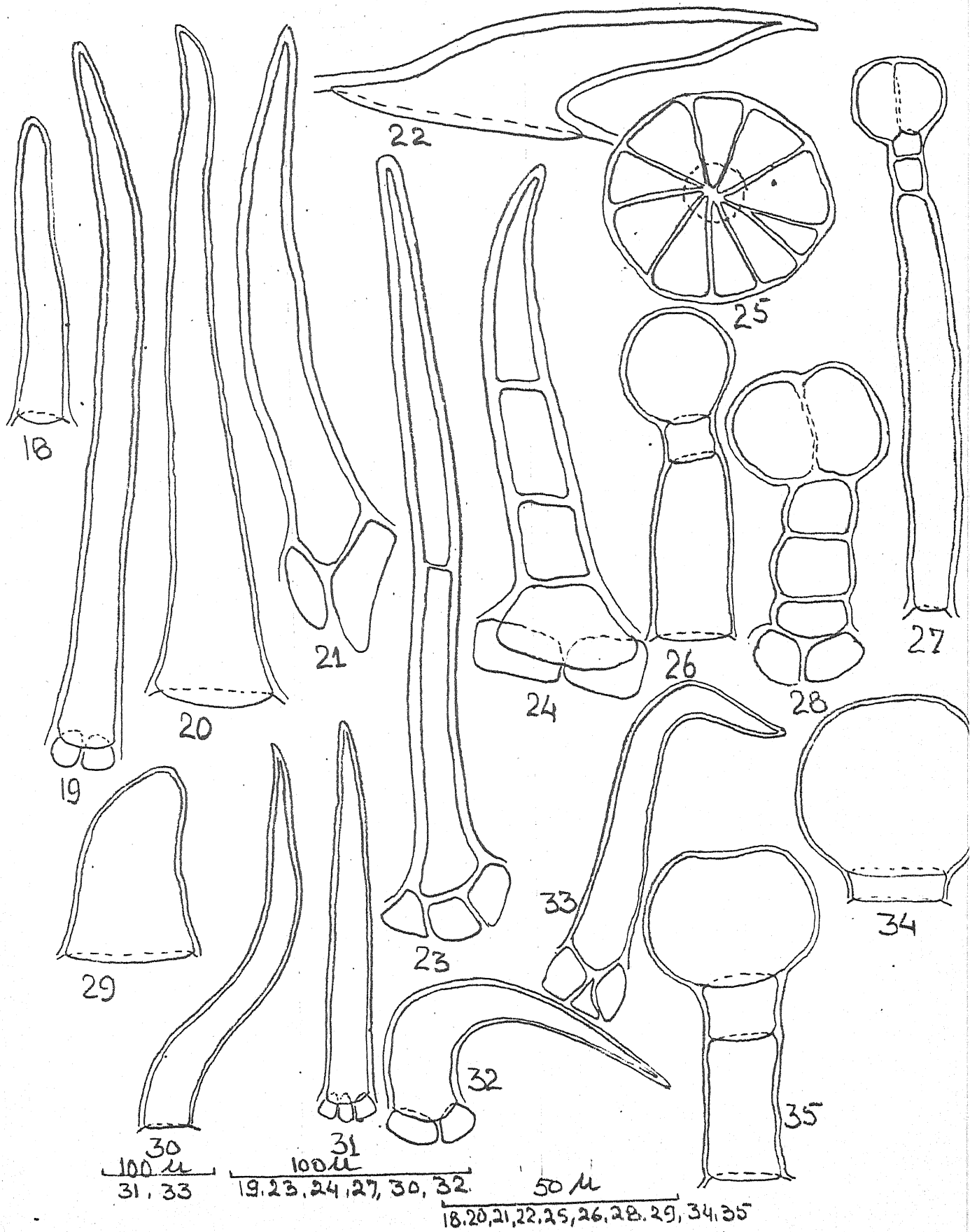
4. UNICELLULAR CURVED HAIR.

Foot: Compound. Body: 1-celled, entire, curved; cell long, tapering & turn aside; tip pointed; walls thin,

Explanation of the figures of Plate 2.
Trichomes from various plant parts.

Figs. 18-28	:	<u>Petrea volubilis</u>
Figs. 18, 25	:	Leaf upper surface.
Figs. 19, 21, 28	:	Calyx.
Figs. 20, 24, 26, 27, 28	:	Stem.
Fig. 22	:	Leaf margin.
Fig. 23	:	Petiole

Figs. 29-35	:	<u>Lippia geminata.</u>
Figs. 29, 33	:	Calyx.
Fig. 30	:	Leaf upper surface.
Figs. 31, 32, 34, 35	:	Stem.



rugose; lumen wide; content translucent Distrib:
Stem, petiole, leaf surface, bract, calyx & corolla
(Fig.32).

5. UNICELLULAR HOOKED HAIR.

Foot: Compound. Body: 1-celled, long, hooked; cell
erect, upper portion turn to be hooked; tip pointed;
walls thin, smooth or rugose; lumen wide, content;
translucent. Distrib. : Stem, petiole, leaf, bract,
calyx & corolla (Fig.33).

6. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled,
very short, discoid, thin walled. smooth, content
translucent; head very large, globose, thin walled,
content light green. Distrib. : Stem. petiole, leaf
surface, bract, calyx & corolla (Fig.34).

7. BICELLULAR GLAUNDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 2-celled,
upper cell short, lower cell prominent, longer than
breadth, lateral & cross walls thin, smooth, content
translucent; head large, capitate, emerginate,
content yellow green. Distrib. : Stem & bract
(Fig.35).

LIPPIA NODIFLORA

This plant shows only three type of trichomes (Plate 3 Fig.36-38).

1. UNICELLULAR CONICAL HAIR.

Foot: Compound. Body: 1-celled, stiffly erect, conical; base wide, sharply tapering; tip pointed; walls thin, smooth, straight; lumen wide; content translucent. Distrib: calyx & corolla. (Fig.36).

2. UNICELLULAR DOLABRATE HAIR.

Foot: Compound. Body: 1-celled, two armed, dolabrate; arms opposite to each other, very long, acuminate & of equal length; walls thin, smooth; lumen wide; content translucent. Distrib: Stem, leaf surface. infl axis, bract & calyx. (Fig.37)

3. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, indistinct; head very large, spherical, hyaline, revealing in folding in the middle; content granulated translucent. Distrib.: Stem. infl. axis, calyx. (Fig. 38)

STACHYTARPHETA INDICA

There are nine type of trichomes observed in this plant(Plate 3. Fig. 39-48).

1. UNICELLULAR PAPILO^LSE HAIR.

Foot: Simple. Body: 1-celled, long, entire, hyaline, papillose; tip obtuse; walls thin, rugose; lumen wide; content translucent. Distrib. : Petiole , leaf lower surface, bract & calyx (Fig.39).

2. UNICELLULAR FLAGELLATE HAIR.

Foot: Simple. Body: very long, narrow, hyaline, flagellate; tip pointed; walls thin, rugose, flexuous; lumen narrow; content translucent. Distrib. : corolla. (Fig. 40).

3. UNICELLULAR CONICAL HAIR.

Foot: Simple. Body: 1-celled, pyramided, conical; base broad; tip pointed; wall thin, rugose, straight; lumen wide; content translucent. Distrib. : Stem, petiole, leaf upper surface, infl. axis & bract. (Fig.41).

4. UNICELLULAR HOOKED HAIR.

Foot: Simple. Body: 1-celled, hooked, cell longer than breadth, turn aside & form hook, tapering to a pointed tip; walls thin, rugose or smooth; lumen wide; content translucent. Distrib.: Stem, petiole, leaf, infl. axis, bract. (Fig. 42).

5. BICELLULAR CYLINDRICAL HAIR.

Foot: Simple. Body: 2-celled, entire, elongated, cylindrical; cells wide and longer than breadth; tip obtuse; lateral and cross walls thin, rugose, convex, deeply constricted at joint; lumen wide; content translucent. Distrib. : Infl. axis. (Fig. 43).

6. BICELLULAR HOOKED HAIR.

Foot: Simple. Body: 2-celled, differentiated, hooked, basal cell wide, curved, upper cell stiffly straight, acuminate; tip pointed; lateral and cross walls thick, rugose, joint deeply constricted; lumen wide; content translucent. Distrib. : Petiole, leaf lower surface & margin, infl. axis (Fig. 44).

7. UNISERiate HOOKED HAIR.

Foot: Simple. Body: 3-5 celled, hooked; cells longer than breadth and of equal size (Fig. 45) or varied

length, basal cell appressed to the surface; tip pointed; lateral and cross walls thin, rugose, constricted at joints; lumen wide; content translucent or opaque. Distrib. : Fig. 45 Leaf margin; Fig. 46-Petiole, leaf-lower surface.

8. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: differentiated; stalk 1-celled, shorter than head, rectangular, thin & smooth walled, content translucent; head large, obovate, grooved in the middle of two glandular cells, walls thin; content dark yellow granulated. Distrib.: Stem, Petiole, leaf surface, infl. axis & calyx (Fig. 47).

9. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: differentiated; stalk 2-celled, upper cell short, collared, rectangular, lower cell prominently wide, longer than breadth, lateral and cross walls thin, smooth, content translucent, head capitate, globose, glandular cells two, arrange lengthwise, walls thin, hyaline, content granulated yellowish. Distrib. : corolla & stamen. (Fig. 48).

NYCTANTHES ARBORTRISTIS

This plant shows seven type of trichomes. (Plate 3 Fig. 49-55).

1. UNICELLULAR FLAGELLATE HAIR.

Foot: Not visible. Body: 1-celled, long, hyaline, flexuous; tip pointed, walls thin, rugose; lumen wide; content translucent. Distrib. : Leaf-lower surface, bract, calyx & corolla (Fig.49).

2. UNICELLULAR CONICAL HAIR.

Foot: Compound. Body: entire, elongated, conical; cell much longer than breadth, tapering to a pointed tip; walls thick, rugose, straight; lumen wide; content light yellow. Distrib.: Stem, petiole, leaf surface, bract, calyx & corolla (Fig.50).

3. UNICELLULAR CURVED HAIR.

Foot: Compound (dark yellow) Body: 1-celled, curved; cell longer than breadth; tip pointed; walls thick; rugose; lumen wide; content light yellow. Distrib.: Petiole, leaf surface & calyx. (Fig. 51).

Explanation of the figures of Plate 3.
Trichomes from various plant parts.

Figs. 36-38 : Lippia nodiflora.

Fig. 36 : calyx.

Fig. 37 : Stem.

Fig. 38 : Calyx.

Figs. 39-48 : Stachytarpheta indica

Figs. 39, 46 : Leaf upper surface.

Figs. 40, 48 : Corolla.

Fig. 41 : Leaf lower surface.

Fig. 42 : Petiole.

Fig. 43 : Infl. axis.

Figs. 44, 45 : Leaf margin.

Fig. 47 : Stem.

Figs. 49-55 : Nyctanthes arbortristis.

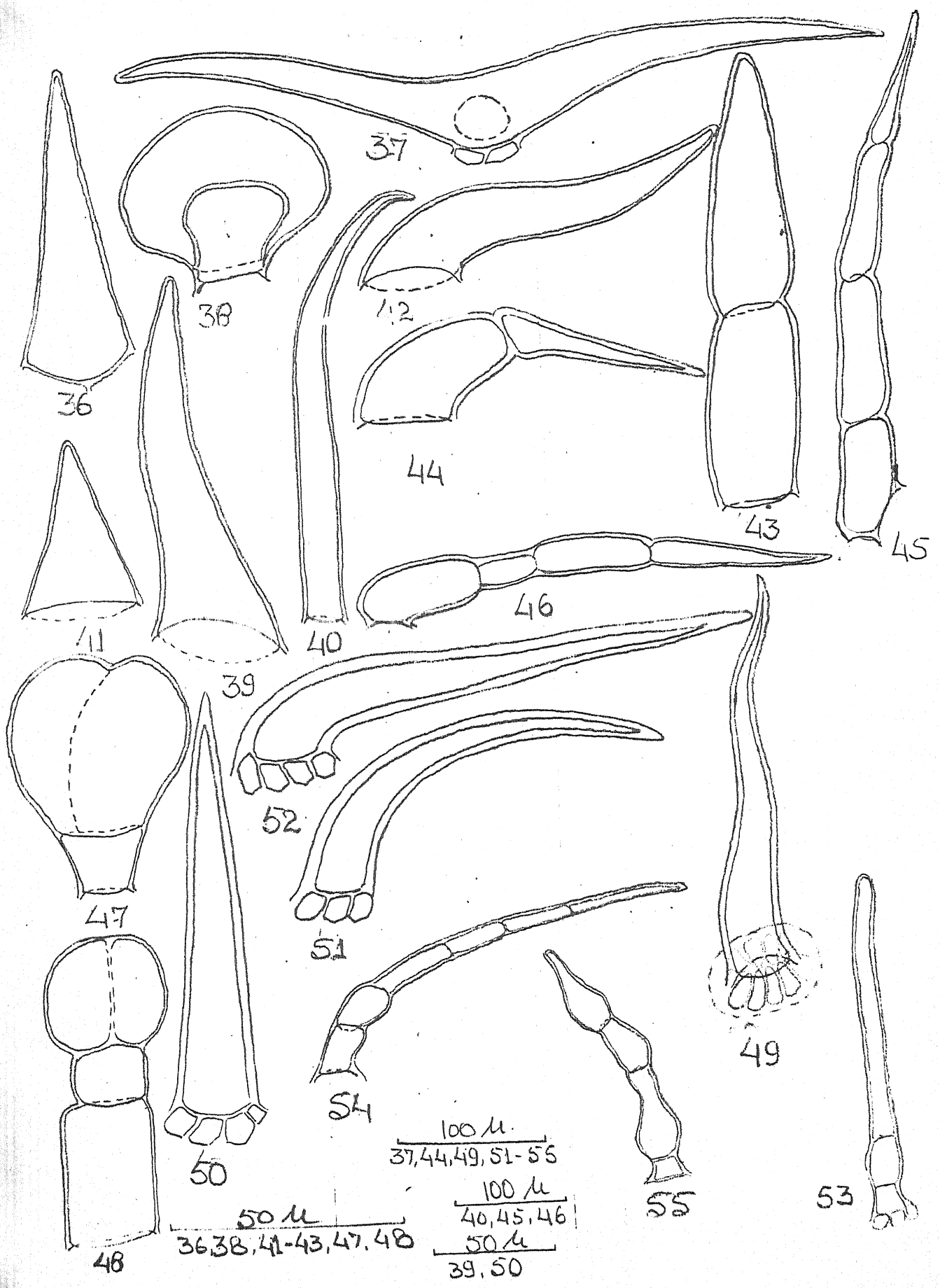
Figs. 49, 55 : Leaf lower surface.

Figs. 50, 52 : Stem.

Fig. 51 - : Petiole.

Figs. 53, 54 : Leaf upper surface.

PLATE-3



100 μ .
 37, 44, 49, 51-55
 100 μ .
 40, 45, 46
 50 μ .
 39, 50

50 μ .
 36, 38, 41-43, 47, 48

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4. UNICELLULAR HOOKED HAIR.

Foot: Compound. (dark yellow). Body: 1- celled, arrect, hooked, cell long; tip pointed; walls thick, rugose; lumen wide; content light yellow. Distrib.: Stem, petiole, leaf, bract & calyx. (Fig. 52).

5. UNISERIATE ASEPTATE FLAGELLATE HAIR.

Foot: Compound. Body: 3-4, celled, long, narrow, differentiated; basal 2-3, cells, erect, short, rectangular, walls thin, rugose, convex, terminal cell very long, tubular, flagellate, tip obtuse, walls thin, rugose; lumen narrow; content opaque (light yellow.) Distrib. : Leaf upper surface (Fig. 53).

6. UNISERITATE HOOKED HAIR.

Foot: Simple. Body: 3-8 celled, hooked, cells of varied length & shapes, narrow, lower cells rectangular, short; upper cells longer than breadth; tip pointed; lateral & cross walls thin, rugose; lumen narrow; content light yellow. Distrib. : Leaf surface & bract. (Fig. 54).

7. UNISERIATE TORRULOSE HAIR.

Foot: Simple. Body: 3-4 celled, torrulose, cells of

varied length & shape, beaded, upper cell narrow; tip obtuse; lateral walls thin, rugose, wavy; cross walls thin; lumen wide; content light yellow. Distrib. : Leaf lower surface.

VERBENA BIPINNATIFIDA

There are twelve type of trichomes observed in this Plant (Plate 4 (Fig. 56-68)).

1. UNICELLULAR PAPILLOSE HAIR.

Foot: Simple. Body: 1-celled, wide, oblong, hyaline, papillose; cell longer than breadth; tip rounded; walls thin, smooth, straight; lumen wide; content translucent. Distrib. : petiole, leaf lower surface & margin, bract, calyx & corolla (Fig. 56).

2. UNICELLULAR ACERATE HAIR..

Foot: Simple. Body: Very long, acerate, tip pointed; walls thin, smooth; lumen wide; content translucent. Distrib. calyx (Fig. 57).

3. UNICELLULAR DENTATE HAIR.

Foot: Simple. Body: 1-celled, stout, erect, dentate; tip pointed; base broad; walls thick, smooth,

straight; lumen wide; content translucent. Distrib.:
Petiole, leaf, bract & calyx (Fig. 58).

4. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: 2-celled, entire, elongated, conical, lower cell wide, oblong, upper cell much longer and narrow than lower; tip obtuse; lateral and cross walls thick, smooth, straight, joint swollen; lumen wide; content translucent. Distrib.: Stem, Petiole, Leaf, infl. axis, bract, calyx and corolla. (Fig. 59).

5. BICELLULAR CURVED HAIR.

Foot: Simple. Body: 2-celled, long, curved; lower cell wide, small, stout and curved, upper cell longer than breadth; tip rounded; lateral and cross walls thin; lumen wide; content translucent. Distrib.: Stem, leaf margin & corolla (Fig. 60).

6. UNISERIATE FILIFORM HAIR.

Foot: Simple. Body: 3-5 celled, entire, filiform; cells of equal length & longer than breadth; tip obtuse; lateral walls thin, smooth or rugose, straight; cross walls thin; lumen wide; content

translucent. Distrib.: Stem, bract, calyx & corolla (Fig.61).

7. UNISERiate HOOKED HAIR.

Foot: Simple. Body: 3-6 celled, long, hooked; cells of varied length, basal cell broadest, curved, terminal cell longest, straight; tapering to a pointed tip; lateral walls thick, rugose, joints thickened; lumen wide; content translucent. Distrib. : Stem, petiole, leaf, calyx (Fig.62).

8. UNISERiate FURCATE HAIR.

Foot: Simple. Body: 5-8 celled, differentiated; stalk 3-celled (Fig. 63) or 1-celled (Fig.64), erect, wide; basal cell terminated into two, 1 to many celled arms (Fig. 63) or furcation bootjack type (Fig.64); furcated cells much longer than breadth; tip obtuse or pointed; lateral walls thin, smooth, straight or curved; cross walls thick; lumen wide; content translucent. Distrib. : (Fig.63) Infl. axis & calyx (Fig.64) Infl. axis, bract & calyx.

9. UNISERiate BRANCHED HAIR.

Foot: Simple. Body; Multicellular, uniseriate, branched; branching start from the base, dividing

cell protude out laterally than divide; tip obtuse or pointed; lateral and cross walls thin, smooth; lumen wide; content translucent. Distrib.: Infl. axis, bract, calyx, & corolla (Fig.65).

10. PELTATE HAIR.

Foot: Not visible. Body: Multicellular, shield-like, circular plate, parallel to epidermis, 1-celled in thickness, 6-8 celled in diameter, cells quadrangular, radiating from hollow center; outer walls thick, smooth, lateral walls thin hyaline; content opaque. Distrib. : Bract, Calyx & corolla.(Fig. 66).

11. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated, stalk 1-celled, short, rectangular, wall thin, smooth, convex content translucent; head globose, large, glandular cells, 2-4, Walls thin, hyaline, content granulated light yellow. Distrib.: Stem, petiole, leaf, infl. axis, bract, calyx and corolla. (Fig.67).

12. UNISERiate GLANDULAR CAPITATE HAIR.

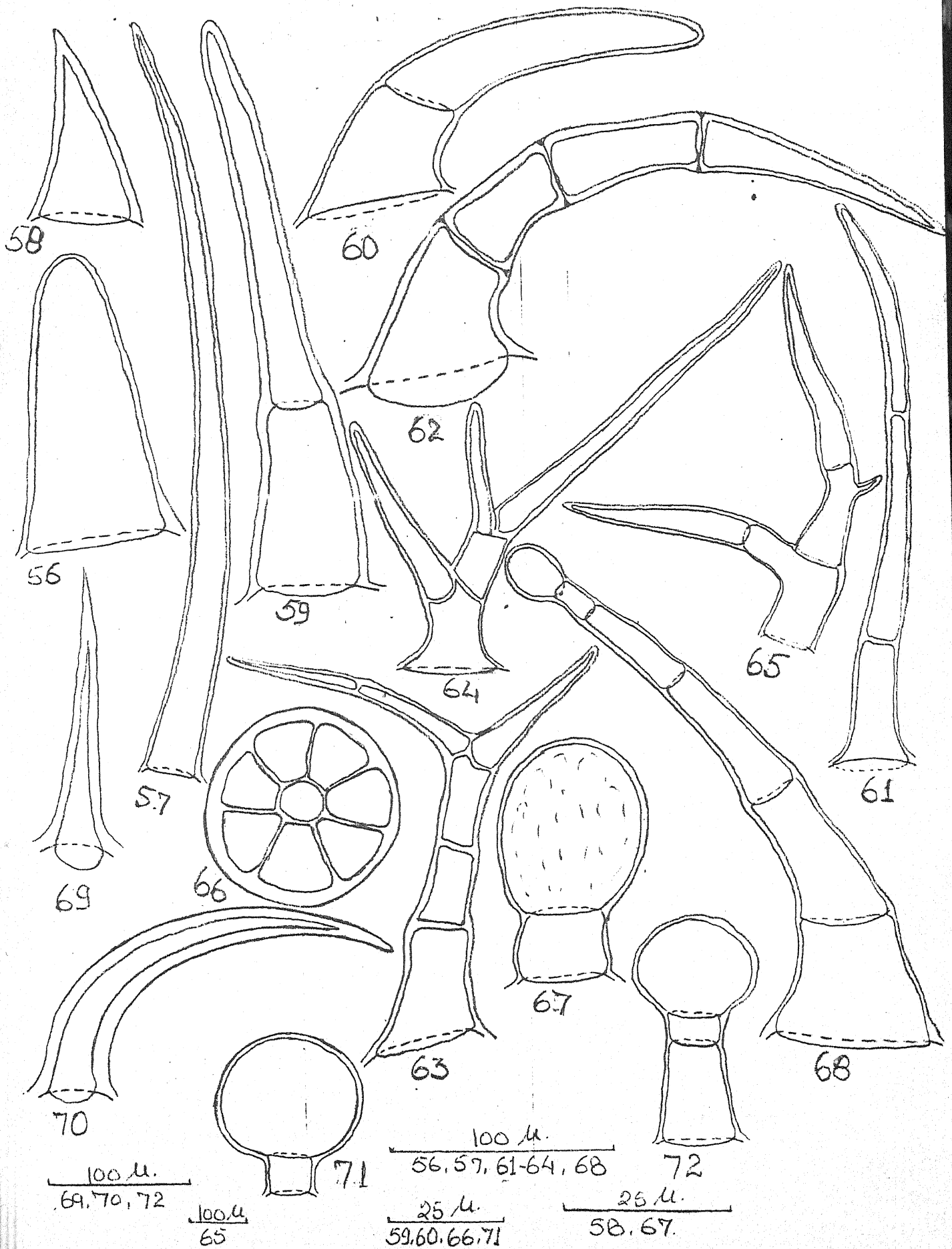
Foot: Simple. Body: Differentiated; stalk 3-5 celled,

Explanation of the figures of Plate 4.
Trichomes from various plant parts.

Figs. 56-68	:	<u>Verbena bipinnatifida.</u>
Figs. 56, 68	:	Petiole.
Figs. 57, 63, 65	:	calyx.
Fig. 58	:	Leaf margin.
Fig. 59	:	Corolla.
Figs. 60, 62, 67	:	Stem.
Figs. 61, 64	:	Infl. axix.
Fig. 66	:	Bract.

Figs. 69-72	:	<u>Verbena bonariensis.</u>
Figs. 69, 72	:	Leaf lower surface.
Fig. 70	:	Bract.
Fig. 71	:	Stem.

PLATE 4



cells of varied length, base much wide, gradually decreasing, walls thin, smooth, swollen, at joint, content translucent; head 1-celled, small, globose, wall thin, content light yellow. Distrib. : Petiole, leaf lower surface, bract, calyx & corolla. (Fig.68).

VERBENA BONARIENSIS.

This plant shows only four type of trichomes. (Plate 4 Fig.69-72).

1. UNICELLULAR CONICAL HAIR.

Foot: Not clearly visible. Body: 1-celled, long, erect, sharply tapering to a long, rigid, pointed tip; walls thick, smooth, straight; lumen narrow; content translucent. Distrib. : Leaf, bract, calyx. & corolla (Fig.69).

2. UNICELLULAR HOOKED HAIR.

Foot: Simple. Body: 1-celled, long, hooked; cell longer than breadth, tip pointed; walls thick; lumen narrow; content opaque. Distrib. : leaf margin, bract, calyx & corolla (Fig.70).

3. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, short, rectangular, walls thin & smooth, content translucent; head 1-celled, prominently large, spherical, walls thin, content granulated yellowish. Distrib.: Stem & calyx (Fig.71).

4. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 2-celled, erect, upper cell short, collared, lower cell longer, prominent, wall thin, smooth, straight, content translucent; head 1-celled large, globose, content dense yellow. Distrib.: Leaf surface, infl. axis, bract, calyx & corolla. (Fig.72).

VERBENA OFFICINALIS

This species shows eight type of trichomes. (Plate 5 Fig.73-80).

1. UNICELLULAR PAPILLOSE HAIR.

Foot: Simple. Body: 1-celled, entire, elongated, cylindrical, papillose; tip rounded; wall, thin,

rugose, straight; lumen wide; content translucent.
 Distrib.: Leaf lower surface & corolla (Fig.73).

2. UNICELLULAR FLAGELLATE HAIR.

Foot: Simple. Body: very long, flagellate, cell longer than breadth; tip obtuse; walls thin, rugose or smooth; lumen wide; content opaque. Distrib.: Stem, leaf-surface, bract & calyx (Fig. 74).

3. UNICELLULAR ACERATE HAIR.

Foot: Simple. Body: Entire, narrowly elongated, acerate; tip obtuse; walls thin, smooth, straight; lumen narrow; content opaque. Distrib.: Stem, leaf surface, bract & calyx. (Fig.75).

4. UNICELLULAR CONICAL HAIR..

Foot: Simple. Body: 1-celled, entire conical; base wide, cell tapering, slightly turn aside; tip pointed; walls thick, smooth; lumen wide; content translucent. Distrib. : Bract, calyx (Fig. 76).

5. UNICELLULAR CURVED HAIR.

Foot: Simple. Body: Entire, curved; cell turn aside & longer than breadth; tip pointed; walls thin,

rugose, lumen wide; content translucent. Distrib.: Stem, leaf-surface, bract & calyx (Fig. 77).

6. UNICELLULAR HOOKED HAIR.

Foot: Simple. Body: 1-celled, arrect, hooked; tip pointed; walls thick, rugose; lumen wide; content translucent. Distrib. Stem. leaf-surface. bract & calyx (Fig. 78).

7. UNICELLULAR TORRULOSE HAIR.

Foot: Simple. Body: very long, narrow, torrulose; tip obtuse; walls thin, smooth, wavy; lumen varied irregular; content translucent. Distrib.: corolla (Fig. 79).

8. PELTATE HAIR.

Foot: Only marking visible. Body: Multicellular, shield-like, circular, 4-6 celled in diameter, parallel to epidermis, 1-celled thickness; cells, triangular, radiating from center; outer wall thick, smooth, hyaline; content opaque. Distrib.: Stem. leaf-surface, bract, calyx corolla (Fig. 80).

DURENTA PLUMERI

It shows ten type of trichomes (Plate 5 Fig. 81-91)

1. UNICELLULAR PAPILLOSE HAIR.

Foot: Simple. Body: 1-celled, entire, long, papillose, cell longer than breadth, base wide & tapering to a rounded tip; wall thin, rugose, straight; lumen wide; content translucent. Distrib. : Leaf-margin. (Fig.81).

2. UNICELLULAR ACUMINATE HAIR.

Foot: Simple. Body: 1-celled, acuminate; cell longer than breadth, base broad, sharply tapering to a pointed tip; walls thin, rugose, lumen wide; content translucent. Distrib. : Petiole.(Fig. 82).

3. UNICELLULAR CONICAL HAIR.

Foot: Simple. Body: 1-celled, entire, conical, base wide, cell longer than breadth, tapering to a pointed tip; walls thick, rugose, straight; lumen wide; content opaque. Distrib. Stem, petiole, leaf & calyx (Fig.83).

4. UNICELLULAR CURVED HAIR.

Foot: Simple. Body: Entire, long, curved, tip pointed; walls thin, rugose; lumen wide; content translucent. Distrib.: Petiole, leaf, infl. axis & calyx (Fig. 84).

5. BICELLULAR FLAGELLATE HAIR.

Foot: Simple. Body: 2-celled, Differentiated, lower cell stout, thin walled; upper cell long, inflated or various shapes, flagellate; tip rounded; lateral and cross wall thin, rugose; lumen wide; content translucent. Distrib. : Infl. axis, calyx (Fig. 85).

6. UNISERiate CURVED HAIR.

Foot: Simple. Body: 3-celled, curved; lower cells small sized, terminal cell much longer than the rest and inflated, curved variously; tip obtuse or rounded; lateral and cross walls thin, rugose; lumen wide; content translucent. Distrib.: Bract & calyx (Fig. 86).

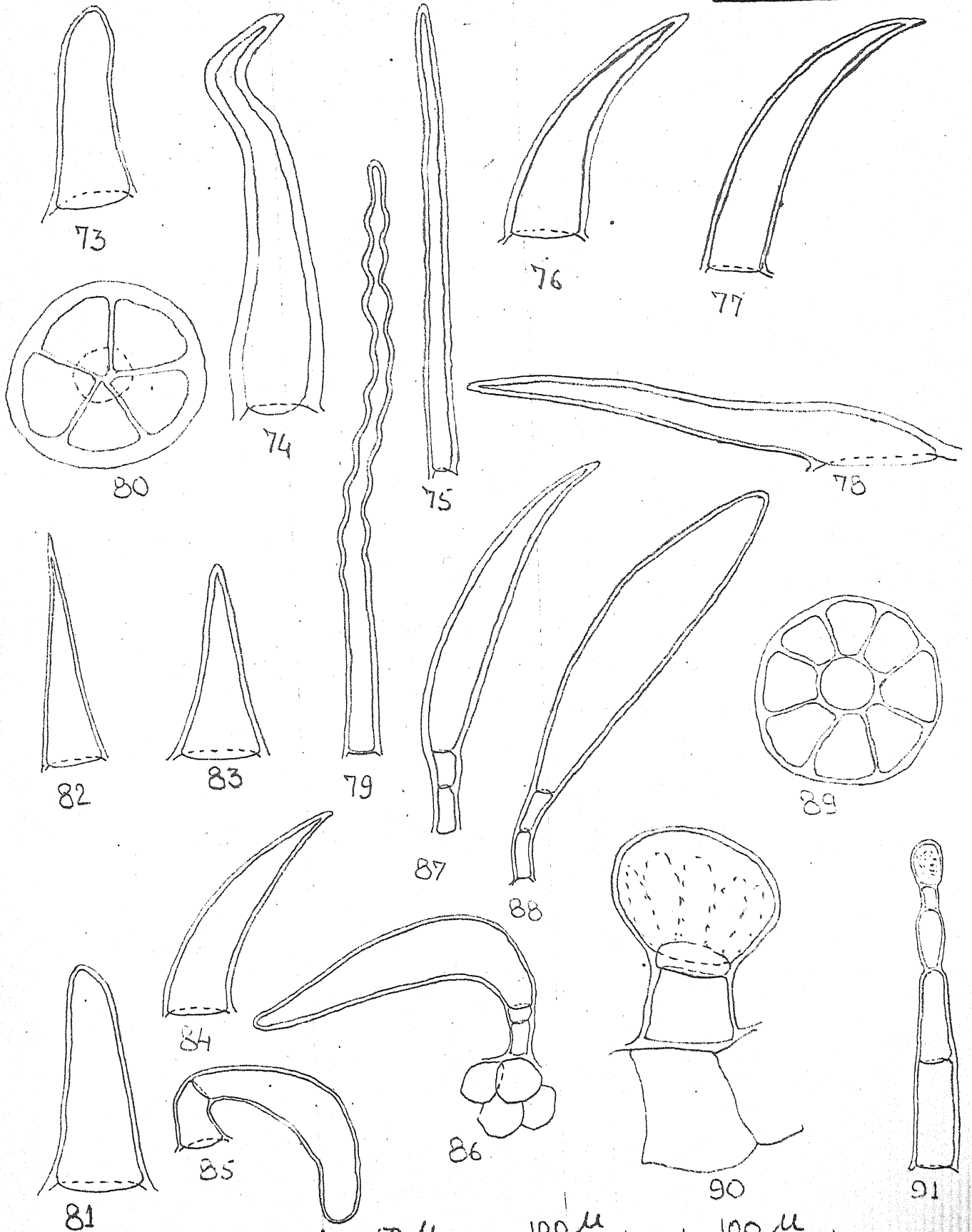
7. UNISERiate FALCATE HAIR.

Foot: Simple. Body: 3-celled, differentiated, falcate; basal two cells short, erect; terminal cell

Explanation of the figures of Plate 5.
Trichomes from various plant parts.

Figs. 73-80	:	<u>Verbena officinalis.</u>
Figs. 73, 74	:	Leaf upper surface.
Figs. 75, 76	:	Bract.
Figs. 77, 78, 80	:	Stem.
Fig. 79	:	Corolla.
Figs. 81-91	:	<u>Durenta plumieri.</u>
Figs. 81, 91	:	Corolla.
Figs. 82, 87, 89	:	Stem.
Fig. 83	:	Leaf margin.
Fig. 84	:	Petiole.
Figs. 85, 86	:	Inlf. axis.
Fig. 88	:	Leaf upper surface.
Fig. 90	:	Leaf lower surface.

PLATE-5



81
 $\frac{50 \mu}{73, 79-84, 87-90}$

$\frac{50 \mu}{74-76, 86}$

$\frac{100 \mu}{77, 78}$

$\frac{100 \mu}{85, 91}$

prominently long & broad, giving distinct shape; tip pointed (Fig. 87) or rounded (Fig. 88); lateral walls thin, rugose; cross walls thin; lumen varied; content translucent. Distrib.: Fig. 87 Stem. petiole, leaf, infl. axis & calyx; Fig. 88 leaf lower surface & infl. axis.

8. PELTATE HAIR.

Foot: not visible. Body: Multicellular, shield-like, circular, 1-celled in thickness, 7- celled in diameter, cells, quadrangular, radiating from hollow. center; outer and lateral walls thin ; content translucent. Distrib. : Stem, Leaf surface & infl. axis (Fig. 89).

9. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Compound. Body: Differentiated; stalk 1-celled, prominent, cubical, walls thick, lumen wide, content translucent; head larger than stalk, globular, consisting many elongated glandular cells, arranged parallel to each other, content opaque granular. Distrib. : Stem, Leaf upper surface & infl. axis (Fig. 90).

10. UNISERiate GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 4-5 celled, filiform, erect, cells varied length and shape, lateral & cross walls thin, rugose, irregular, constricted at joints, content opaque; head 1-celled, small, globose, wall thin, content granulated light yellow. Distrib.: Corolla & Stamen. (Fig. 91).

CALLICARPA-LANATA

This species shows eight type of trichomes. (Plate 6. Fig. 92-99).

1. UNICELLULAR FLAGELLATE HAIR.

Foot: Simple. Body: very long, flagellate; tip obtuse; walls thick, smooth; lumen narrow; content translucent. Distrib.: Leaf- lower surface. (Fig. 92).

2. UNICELLULAR ACERATE HAIR.

Foot: Simple. Body: 1-celled, very much elongated, straight, base wide: tip acuminate; wall thin, smooth, straight; lumen narrow; content translucent. Distrib.: Leaf lower surface. (Fig. 93).

3. STELLATE TRI-RADIATE HAIR.

Foot: Not visible. Body: 3-celled, triradiate; arms unicellular and of varied length, commonly two arms short, pear shaped or conical, one arm very long, filiform; walls thick; lumen varied; content opaque. Distrib: leaf, calyx, gynoecium. (Fig.94)

4. STELLATE MULTIRADIATE HAIR.

Foot: Simple. Body: Multicellular, multiradiate stellate, appressed to the epidermis; arms radiating from common center; unicellular, elongated, shaped variously with broad base; tip pointed; walls thick; lumen wide; content opaque. Distrib. : calyx. (Fig.95).

5. DENDROID HAIR.

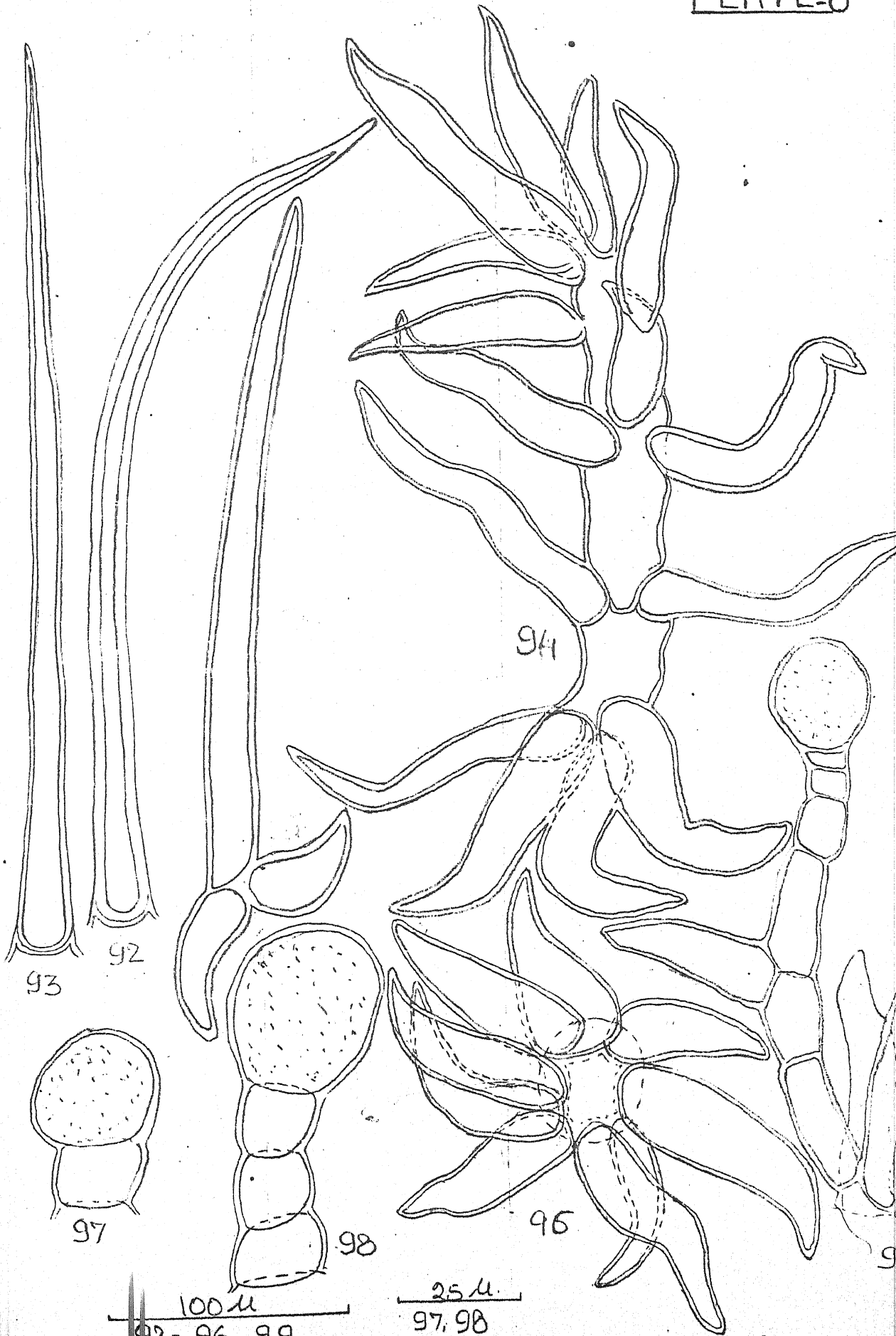
Foot: Not visible. Body: Multicellular, uniseriate, multibranched dendroid, branches unicellular, elongated, arising irregularly from the stiff. common axis; tip of arms acute or obtuse; lateral & cross walls thin; lumen wide; content opaque. Distrib.: Petiole, leaf, calyx (Fig.96).

Explanation of the figures of Plate 6.
Trichomes from various plant parts.

Figs. 92-99	:	<u>Callicarpa lenata.</u>
Figs. 92, 93	:	Leaf upper surface.
Figs. 94, 95	:	Calyx.
Fig. 96, 98	:	Petiole.
Fig. 97	:	Corolla.
Fig. 99	:	Leaf lower surface.

PLATE-6

ures of Plate
on plant parts
Laccaria lenata
f upper surface
yx.
sole
olla
lower surface



6. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled rectangular, shorter than head, wall thin, smooth, content translucent; head 1-celled, globose, thin walled, content granulated light yellow. Distrib. Corolla (Fig.97).

7. UNISERIATE GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk, 3-celled, uniseriate, cells some what spherical, overlapping, walls thin, convex, smooth, constricted at joints, content translucent; head 1-celled, large globose, thin walled, content granulated yellowish. Distrib: Petiole, leaf-lower surface, infl. axis (Fig.98).

8. DENDROID GLANDULAR CAPITATE HAIR.

Foot: Not visible. Body: Multicellular, uniseriate, dendroid, differentiated; arms arises from main uniseriate axis; axis terminate into glandular, globose head; content translucent in arms and dense granulated in head. Distrib.: Leaf upper surface. (Fig. 99).

CALLICARPA MACROPHYLLA

This plant shows five type of trichomes. (Plate 7 Fig. 100-104).

1. UNICELLULAR FLAGELLATE HAIR.

Foot: Simple. Body: 1-celled, entire, very long, flagellate; tip pointed; walls thin, smooth; lumen wide; content translucent. Distrib.: Petiole. (Fig. 100).

2. STELLATE MULTIRADIATE HAIR.

Foot: Simple Body: Multicellular, multiradiate stellate, appressed to the epidermis, arms radiating from common center, unicellular, elongated, overlapping, various shaped with broad base; tip obtuse or pointed; walls thin; lumen wide; content opaque. Distrib. : Stem, leaf Surface, infl. axis (Fig. 101).

3. PELTATE HAIR.

Foot: Not visible. Body: Multicellular, shield like, circular, parallel to epidermis, 1-celled in thickness, 7-10 celled in diameter; cells quadrangular, radiating from hallow center; outer and

lateral wall thin; content opaque. Distrib.: Stem, petiole, leaf surface, infl. axis, Bracts & calyx (Fig.102).

4. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: clavate, differentiated; stalk 1-celled, rectangular, wall thin, smooth, content translucent; head 1-celled, large, obovate, thin walled, content opaque. Distrib.: Stem. Petiole, leaf surface, infl. axis. & calyx (Fig.103).

5. UNISERIATE GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated ; stalk 3-celled, cylindrical, erect, cells longer than breadth, walls thin, smooth & straight content translucent; head; 1-celled large globose, walls thin, smooth, content pale green. Distrib.: Petiole, leaf lower surface & infl. axis (Fig.104).

CALLICARPA TOMENTOSA

This plant shows seven type of trichomes. (Plate 7 Fig. 105-111).

1. UNICELLULAR CONICAL HAIR.

Foot: Simple. Body: 1-celled, short, stout , conical;

cell sharply tapering; tip obtuse; walls thick, smooth, straight; lumen narrow; content translucent. Distrib.: Bract & calyx (Fig.105).

2. UNICELLULAR HOOKED HAIR.

Foot: Simple. Body: 1-celled, small, hooked, cell longer than breadth; tip obtuse; walls very thick, smooth; lumen narrow; content opaque enavescent. Distrib: Bract & calyx (Fig.106).

3. BICELLULAR FILIFORM HAIR.

Foot: Compound. Body: 2-celled, entire, filiform; cell of varied length and longer than breadth; tip obtuse; lateral walls thick; lumen narrow; content translucent. Distrib.: - Bract & calyx (Fig. 107).

4. BICELLULAR HOOKED HAIR.

Foot: Compound. Body: Elongated, hooked; cells of varied length, and cells narrowly elongated; tip pointed; lateral walls thick, rugose, straight and joint distinct; cross walls thick; lumen narrow; content opaque. Distrib. : Leaf margin, bract & calyx (Fig.108).

5. UNISERiate HOOKED HAIR.

Foot: Compound. Body: 3-5 celled, elongated, hooked; cells longer than breadth; geniculate, tip pointed; lateral walls thick, rugose, straight, joint swollen; cross walls thick, lumen narrow; content translucent. Distrib.: Stem, bract & calyx (Fig.109).

6. DENDROID HAIR.

Foot: Simple. Body: Multicellular, uniseriate, multibranded dendroid; branches Unicellular, elongated, arising irregularly from common axis; tip of arms pointed or obtuse; lateral and cross walls thin; lumen wide; content translucent. Distrib.: Petiole, leaf. (Fig.110).

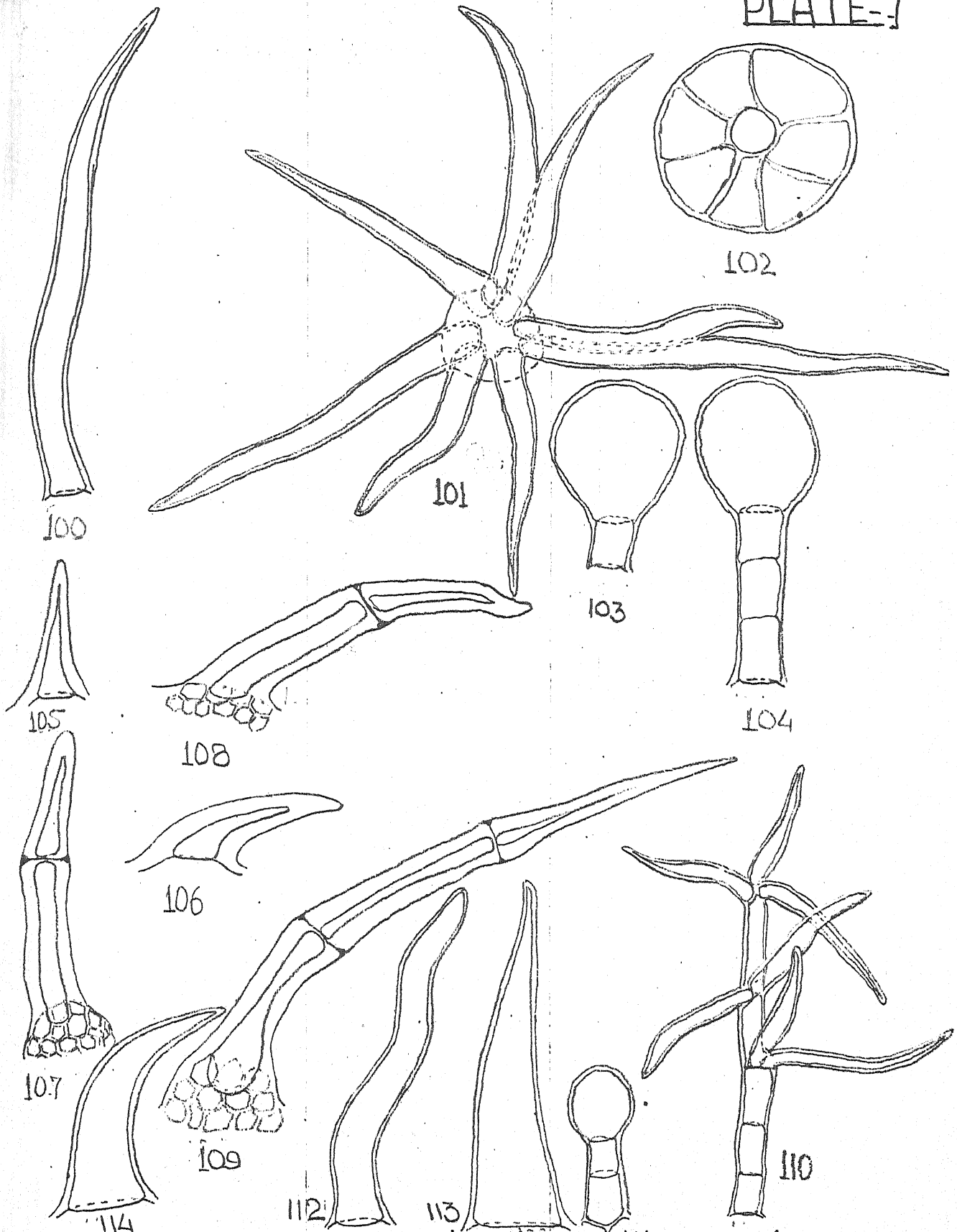
7. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Compound. Body: Differentiated, stalk 2-celled, erect, cells shorter than head, lateral walls thin, smooth, straight, content translucent; head 1-celled, capitate, globose, thin & smooth walled, content opaque. Distrib.: Petiole, leaf surface. (Fig.111).

Explanation of the figures of Plate 7.
Trichomes from various plant parts.

Figs. 100-104	:	<u>Callicarpa macrophylla.</u>
Figs. 100, 104	:	Petiole.
Fig. 101	:	Leaf upper surface.
Figs. 102, 103	:	Stem.
Figs. 105-111	:	<u>Callicarpa tomentosa.</u>
Figs. 105, 106, 107, 108	:	Bract.
Fig. 109	:	Stem.
Figs. 110, 111	:	Petiole.
Figs. 112-114	:	<u>Tectona grandis.</u>
Figs. 112, 114	:	Leaf lower surface.
Figs. 113	:	Leaf upper surface.

PLATE-7



$\frac{100\mu}{108-110}$
 $\frac{100\mu}{112-114}$
 $\frac{50\mu}{101, 104}$
 $\frac{111 \quad 50\mu}{100, 102, 103, 105-107, 111}$

TECTONA GRANDIS

This plant have seven type of trichomes (Plate 7 & 8 Fig.112-119).

1. UNICELLULAR FLAGELLATE HAIR.

Foot: Simple. Body: Elongated, flagellate, cell very long cylindrical, hyaline, flexuous; tip obtuse; wall thin, smooth, wavy; lumen wide; content translucent. Distrib.: Leaf-lower surface. (Fig.112).

2. UNICELLULAR CONICAL HAIR.

Foot: Simple. Body: Entire, elongated, conical; broad base, gradully tapering; tip pointed; tip obtuse; wall thin, smooth, straight; lumen wide; content translucent. Distrib.: Leaf-surface.(Fig. 113).

3. UNICELLULAR HOOKED HAIR.

Foot: Simple. Body: 1-celled, entire, hooked, cell longer than breadth & turn aside; tip acute; walls thick, smooth, lumen wide; content translucent. Distrib.: Leaf-lower surface. (Fig.114).

4. DENDROID HAIR.

Foot: Simple. Body: Multicellular, tufted, dendroid,

differentiated; basal portion 2-celled, erect, upper portion dichotomously divided into unicellular short prolongations; cells of varied shapes; lateral & cross walls thin or thick, smooth; lumen wide; content opaque. Distrib.: Stem, Petiole, leaf, infl. axis, bract, calyx, corolla, & Gynoecium. (Fig.115).

5. PELTATE HAIR.

Foot: Not visible. Body: Multicellular, shield like, circular, parallel to epidermis, 1-cells in diameter, cells narrow, elongated, clavate, radiating from center, like fan, outer & lateral walls thin; content opaque. Distrib.: Bract & Calyx. (Fig.116).

6. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 2-celled, short, upper cell small, rectangular, lower large, prominent, longer than breadth, wall thin & smooth, content translucent; head 1-celled, large, capitate, thin walled, content light yellow. Distrib.: Stem, petiole, leaf surface, bract, calyx, corolla & ovary wall. (Fig.117).

7. UNISERIATE GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 3-celled,

cells of varied length, thin & smooth walled, content translucent; head 1-celled, large, globose, thin walled, content light yellow. Distrib.: Petiole, leaf-lower surface & margin, bract. (Fig. 118).

8. DENDROID GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Multicellular, uniseriate, dendroid, differentiated; some arms multicellular, filiform, bearing unicellular, globose; glandular head, content translucent in the arms and granulated dense in head. Distrib.: Leaf lower surface & corolla (Fig. 119).

PREMNA LATIFOLIA

This plant shows fourteen type of trichomes (Plate 8 Fig. 120-133).

1. UNICELLULAR PAPILLOSE HAIR.

Foot: Simple. Body: Small, inflated, domed, papillose, tip rounded; walls, thin, smooth or rugose, wavy; lumen wide; content translucent. Distrib. Calyx & Corolla. (Fig. 120).

2. UNICELLULAR FLAGELLATE HAIR.

Foot: Simple. Body: long, tubular, flagellate, cells narrow, longer than breadth; tip obtuse; walls thin, rugose, wavy; lumen wide; content translucent. Distrib. Calyx corolla. (Fig. 121).

3. UNICELLULAR CONICAL HAIR.

Foot: Simple. Body: 1-celled, entire elongated, conical; tip obtuse; walls thin, rugose, straight; lumen wide; content translucent. Distrib.: Stem, Leaf, Infl. axis, calyx & corolla. (Fig. 122).

4. UNICELLULAR HOOKED HAIR.

Foot: Simple. Body: 1-celled, arrect, hooked, cell longer than breadth; tip obtuse; wall thin, rugose, straight; lumen wide; content translucent. Distrib.: Calyx & corolla. (Fig. 123).

5. UNICELLULAR TORRULOSE HAIR.

Foot: Simple. Body: Very long, narrow, torrulose; cell narrowly elongated; tip obtuse; walls thin, rugose, wavy; lumen narrow; content light yellow. Distrib.: Corolla (Fig. 124).

6. BICELLULAR FLAGELLATE HAIR.

Foot: Simple. Body: 2-celled, long, flagellate, differentiated; stalk 1-celled, short, wall thin & rugose, lumen narrow, content light yellow; upper cell very long, narrowly flagellate, tip pointed, wall thin, rugose, joint swollen; lumen narrow; content dark yellow. Distrib.: Corolla. (Fig.125).

7. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: 2-celled, conical; cells wide, upper cell longer than lower; tip pointed; lateral walls thick, smooth or rugose, straight, joint swollen; cross walls, thin; lumen wide; content translucent. Distrib.: Stem petiole, leaf, infl. axis, calyx. (Fig.126).

8. BICELLULAR HOOKED HAIR.

Foot: Simple. Body: 2-celled, elongated, hooked, cells much longer than breadth; tip pointed or obtuse; lateral walls thick, smooth or rugose, straight; cross walls thin; lumen narrow; content translucent. Distrib: Stem, petiole, leaf. infl. axis. calyx. (Fig. 127).

9. UNISERiate FILIFORM HAIR.

Foot: Simple. Body: 3-6 celled, uniseriate, filiform; cells longer than breadth, small; tip obtuse, lateral & cross walls thick, rugose; lumen wide; content opaque. Distrib.: petiole, leaf-surface & calyx. (Fig.128).

10. UNISERiate CONICAL HAIR.

Foot: Compound. Body: 3-celled, conical; base wide, cells of varied length; tip pointed; lateral and cross walls thick, smooth, joints swollen; lumen wide; content opaque. Distrib. Stem, petiole, leaf, infl. axis. (Fig.129).

11. UNISERiate HOOKED HAIR.

Foot: Compound. Body: 3-5 celled, hooked; cells longer than breadth & narrow; tip obtuse; lateral walls thick, rugose; cross walls thick; lumen narrow; content opaque. Distrib. Stem, petiole & leaf (Fig.130)

12. UNISERiate FURCATE HAIR.

Foot: Simple. Body: 3-celled, differentiated; stalk 1-celled, erect, terminated into two 1 to many celled

arms; arms cell longer than breadth, base wide; tip obtuse or pointed; lateral walls thin, smooth; cross walls thin; lumen wide; content translucent. Distrib.: Leaf margin & calyx. (Fig.131).

13. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, short, thin walled, content translucent; head 1-celled, very large, globose, wall thick, content granular opaque Distrib.: Leaf surface, infl. axis. calyx & corolla. (Fig.132).

14. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated, stalk ,2-celled, dumbbell shaped, cells of varied length, upper cell short, lower large & prominent, walls thin, smooth & curved, content translucent; head multicellular, large, globose, cells hyaline, narrow, elongated, arranged lengthwise, parallel to each other, lateral and outer walls thick, hyaline, content opaque. Distrib.: Stem, petiole, leaf-lower surface, infl. axis & calyx. (Fig.133).

PREMNA WIGHTIANA

There are eleven type of trichomes observed in this plant. (Plate 8 & 9 Fig.134 - 146).

1. UNICELLULAR FLAGELLATE HAIR.

Foot: Simple. Body: 1-celled, very long, flagellate; cell narrowly flagellate; tip pointed; walls thin, rugose; lumen narrow; content translucent. Distrib.: Corolla & Style . (Fig. 134).

2. BICELLULAR CYLINDRICAL HAIR.

Foot: Simple. Body: 2-celled, small, cylindrical; cells rectangular; tip rounded; lateral walls thin, smooth or rugose, convex, constricted at joint; lumen wide; content translucent. Distrib.: Calyx & corolla. (Fig.135).

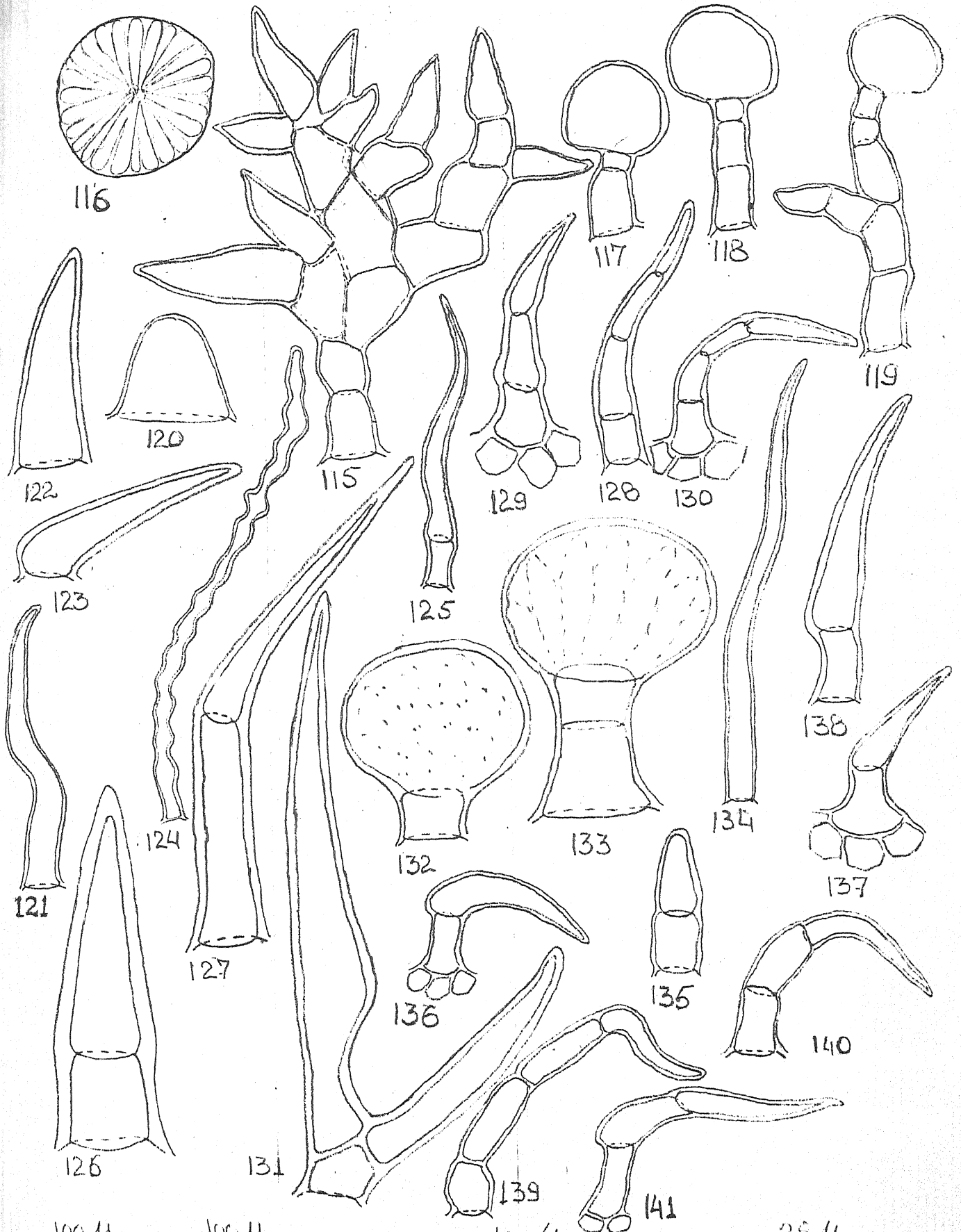
3. BICELLULAR CURVED HAIR.

Foot: Compound. Body: 2-celled, entire, curved, differentiated; upper cell turn aside, falcate, cell longer than breadth, base swollen; lower cell short and narrow; tip obtuse; lateral and cross walls thin, smooth; lumen wide; content translucent. Distrib.:

Explanation of the figures of Plate 8.
Trichomes from various plant parts.

Figs. 115-119	:	<u>Tectona grandis.</u>
Figs. 115, 117	:	Stem.
Fig. 116	:	Bract.
Fig. 118	:	Petiole.
Fig. 119	:	Leaf lower surface.
Figs. 120-133	:	<u>Premna litifolia.</u>
Figs. 120, 121,	:	Calyx.
122, 123, 131	:	
Figs. 124, 125	:	Corolla.
Figs. 126, 132	:	Leaf upper surface.
Figs. 127, 130, 133	:	Stem.
Figs. 128, 129	:	Leaf lower surface.
Figs. 134-141	:	<u>Premna wightiana.</u>
Fig. 134	:	Corolla.
Fig. 135	:	Calyx.
Figs. 136, 137,	:	Stem.
138, 140, 141	:	
Fig. 139	:	Leaf upper surface.

PLATE-8



100 μ
124, 124

100 μ
116, 125, 128-130, 135, 139-141

100 μ
115, 117-119, 121-123, 127, 136-138

25 μ
120, 126, 131-133

Stem, infl. axis, calyx (Fig.136).

4. BICELLULAR HOOKED HAIR.

Foot: Compound. Body: 2-celled, short, hooked, differentiated; uppercell longer than lower and lanceolate, seated on lower short, erect cell, base rounded and wide; tip pointed; lateral and cross walls thin, smooth; lumen wide; content translucent. Distrib.: Stem, leaf surface, infl. axis, calyx. (Fig.137)..

5. BICELLULAR BELEMNOID HAIR.

Foot: Simple. Body: 2-celled, belemnoid, lower cell wide and short, upper all narrowly elongated, tapering to a pointed tip, lateral and cross walls thin, smooth and straight, lumen narrow, content translucent. Distrib.: Stamen (Fig. 138).

6. UNISERiate SEPTATE FLAGELLATE HAIR.

Foot: Compound. Body: 3-4 celled, long, flagellate; cells of varied length, swollen base, upper cell longer than breadth, terminal cell longest; tip obtuse or pointed; lateral and cross walls thin, smooth; lumen wide; content translucent. Distrib. :

Stem , petiole, leaf-surface, infl. axis & calyx.
(Fig.139).

7. UNISERiate CURVED HAIR.

Foot: Simple. Body: 3-6, celled, entire, curved; cells longer than breadth, turn aside; tip pointed; lateral and cross walls thin smooth, lumen wide, content translucent. Distrib. : petiole, leaf-surface & calyx. (Fig. 140).

8. UNISERiate HOOKED HAIR.

Foot: Compound. Body: 3-6 celled, hooked; cells longer than breadth, base rounded and wide- (Fig.142) or base narrow (Fig.141) tip pointed; lateral and cross walls thin, smooth, lumen wide; content translucent. Distrib.: Fig. 141-stem petiole infl. axis. calyx; Fig.142-stem, leaf-surface, infl. axis & calyx.

9. UNISERiate ACUMINATE HAIR.

Foot: Simple. Body: 3-7 celled, acuminate, cells small rectangular (Fig. 143) ovular (Fig. 144) terminal cell narrow & acuminate; tip pointed; lateral walls thin, smooth, convex or concave; lumen

wide; content translucent. Distrib: Fig.143-stem, leaf surface, infl. axis, Fig. 144-calyx.

10. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, short, collared, shorter than head, walls thin, smooth, content translucent; head 1-celled, large, globose, thin walled, smooth, content translucent; head 1-celled, large, globose, thin walled, smooth, content light yellow. Distrib. : petiole, leaf-surface, calyx, corolla (Fig. 145).

11. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Compound. Body: Differentiated; stalk 2-celled, erect, gradually tapering, upper cell short & stout, lower cell large and prominent, walls thin and smooth, content translucent; head 1-celled, large, globose, walls thin, content light yellow. Distrib.: Stem, infl. axis. & calyx. (Fig.146).

GMELINA ARBOREA

This plant shows nine type of trichomes. (Plate 9 Fig. 147-156).

1. UNICELLULAR PAPILLOSE HAIR.

Foot: Simple. Body: 1-celled, elongated, papillose;

hyaline, variously wide; wall thin, smooth, lumen narrow; content translucent. Distrib. : Corolla (Fig. 147).

2. BICELLULAR ASEPATE FLAGELLATE HAIR.

Foot: Simple. Body: 2-celled, differentiated, flagellate lower cell short, rectangular, thin & smooth walled, content dark green; upper cell narrowly flagellated, base wide; tip pointed; walls thin & smooth, lumen narrow, content light green. Distrib. : Stem, leaf margin, bract, calyx & corolla (Fig. 148).

3. BICELLULAR CYLINDRICAL HAIR.

Foot: Simple. Body: Large, wide, cylindrical; upper cell very long, shaped variously; lower cell much small; lateral and cross wall thick, smooth, straight; lumen wide; content light green. Distrib.: Stem, petiole, infl. axis. corolla (Fig. 149).

4. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: Elongated, entire, conical; cells much longer than breadth; tapering to a pointed tip; lateral and cross walls thin, rugose, straight;

lumen wide; content translucent. Distrib.: Leaf upper surface & Stamen. (Fig.150).

5. UNISERiate SEPTATE FLAGELLATE HAIR.

Foot: Simple. Body: 3-5 celled, very long, flagellated differentiated; stalk 1-celled, cubical, erect, rest of the cells much longer than breadth, flexuous; lateral walls thick smooth; cross walls thin, tip pointed; lumen wide; content light green except in stalk cell (dark green). Distrib.: Stem, petiole, leaf, infl. axis, bract, calyx. & corolla (Fig.151).

6. UNISERiate CYLINDRICAL HAIR.

Foot: Simple. Body: 3-celled, entire, cylindrical; cells broad, oblong and longer than breadth; tip rounded; lateral and cross walls thin, smooth, convex; lumen wide; content translucent. Distrib. Infl. axis (Fig. 152).

7. UNISERiate HOOKED HAIR.

Foot: Simple. Body: 3-6 celled, hooked; cells, distinctly broad and of varied length, hyaline, lateral walls deeply constricted at joints (Fig.153)

or cells normally longer than breadth except the lower most cell (Fig. 154) tip obtuse or pointed; lateral walls thick or thin, straight or convex, joint constricted; cross walls thick or thin; lumen wide; content opaque. Distrib.: Fig 153-Stem, petiole, leaf lower surface, infl. axis, bract, calyx, corolla; Fig. 154-Leaf, infl. axis, bract, calyx. & corolla.

8. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, shorter than head, cell wide than length, walls thin and smooth, lumen wide, content opaque (violet); head 1-celled very large, globose, thin walled, content light yellow. Distrib. Petiole, leaf, bract, corolla, stamen (Fig. 155).

9. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 2-celled, upper cell rectangular & narrower than lower domed cell; wall thin & smooth; head multicellular, large, elevated, glandular cells elongated and of varied size & shape, arranged in one tier, parallel to each other, walls thin, content opaque. Distrib.: Stamen. (Fig. 156).

GMELINA PHILIPPENSIS

This plant shows ten type of trichomes. (Plate 9 Fig. 157-166).

1. UNICELLULAR CURVED HAIR.

Foot: Simple. Body: 1-celled, small curved; cell longer than breadth; tip acute; walls thin, smooth; lumen narrow; content opaque. Distrib.: Leaf lower surface, calyx & corolla. (Fig.157).

2. UNICELLULAR DENTATE HAIR.

Foot: Simple. Body: 1-celled, short, stout, pear shaped, dentate; tip pointed; walls thick, lumen wide; content opaque. Distrib: Calyx. & Corolla (Fig. 158)

3. BICELLULAR ASEPTATE FLAGELLATE HAIR.

Foot: Simple. Body: 2-celled, short, flagellate, differentiated; lower cell small, straight; upper cell comparatively much long, flexuous, tip pointed; walls thin, smooth; lumen narrow; content opaque, Distrib.: Calyx & corolla (Fig.159).

4. BICELLULAR CYLINDRICAL HAIR.

Foot: Simple. Body : 2-celled, small, entire, cylindrical; cells longer than breadth, narrow; tip obtuse; walls thin or thick and smooth; lumen wide; content opaque. Distrib.: Calyx. (Fig.160).

5. BICELLULAR HOOKED HAIR.

Foot: Simple. Body: 2-celled, short, sharply hooked; lower cell short, curved upper cell straight, conical; tip obtuse; lateral walls thick, smooth, cross wall thin; lumen wide; content opaque. Distrib. : Petiole, leaf-lower surface, calyx & corolla (Fig.161).

6. UNISERiate SEPTATE FLAGELLATE HAIR.

Foot: Simple. Body: 3-6 celled, long, beaded, flagellate; cells small sized & longer than breadth; tip acute, lateral walls thin, smooth, deeply constricted at joints; cross walls thin; lumen narrow; content opaque. Distrib. : Calyx. (Fig. 162).

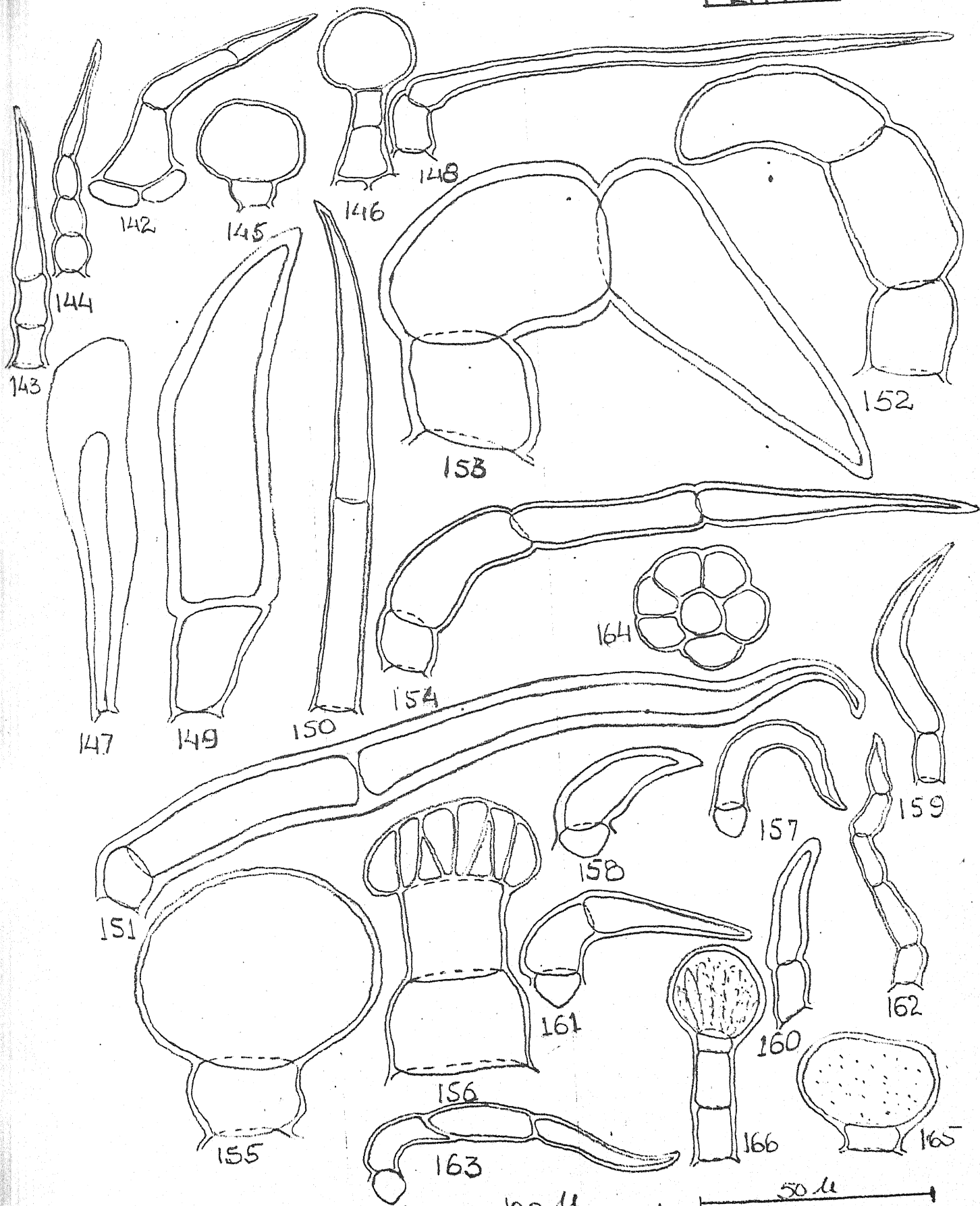
7. UNISERiate HOOKED HAIR.

Foot: Simple. Body: 3-4 celled, entire, hooked, cells longer than breadth, basal cell curved; tip acute &

Explanation of the figures of Plate 9.
Trichomes from various plant parts.

- Figs. 142-146 : Premna wightiana.
- Figs. 142, 143, 146 : Stem.
Fig. 144 : Calyx.
Fig. 145 : Leaf upper surface.
- Figs. 147-156 : Gmelina arborea.
- Figs. 147, 149 : Corolla.
Figs. 148, 151, 153 : Stem.
Figs. 150, 156 : Stamen filament.
Fig. 152 : Infl. axis.
Fig. 154 : Leaf lower surface.
Fig. 155 : Petiole.
- Figs. 157-166 : Gmelina philippensis.
- Figs. 157, 158, 159, 160, 162 : Calyx.
Figs. 161, 164, 165 : Petiole.
Fig. 163 : Leaf upper surface.
Fig. 166 : Stamenal filament.

PLATE 9



100 μ
144, 150, 154, 157, 159-163, 166

100 μ
142, 143, 146-148, 151

25 μ
153, 155, 165

50 μ
145, 149, 152, 156, 158, 164

upward; lateral and cross walls thick or thin, smooth, straight, joint constricted; lumen wide; content opaque. Distrib: Leaf lower surface, calyx & corolla. (Fig. 163).

8. PELATATE HAIR.

Foot: Not visible. Body: Multicellular, peltate, shield like, circular, 1-celled in thickness, 6-9 celled in diameter, cells rectangular, radiating from hollow center; outer walls thin, wavy, culinised; lateral walls thin, hyaline; content opaque. Distrib.: Petiole & leaf lower surface (Fig. 164).

9. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, short, collared, rectangular thin and smooth walled, content translucent; head 1-celled, large, globose, thin walled, content granulated opaque. Distrib.: petiole (Fig. 165).

10. UNISERiate GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 2-3 celled, cells of varied length and longer than breadth except upper most collar cell, walls thin & smooth, content

translucent; head large, capitate, glandular cells many & longitudinally arranged, walls thin, content translucent, Distrib.: Stamen. Fig.166)

VITEX NEGUNDO

Species shows thirteen type of trichomes. (Plate.10 Fig.167-179)

1.UNICELLULAR PAPILLOSE HAIR.

Foot: Simple. Body: Entire, elongated, hyaline, papillose; cell wide and tapering to a obtuse tip; walls thin, smooth, straight; lumen wide; content translucent. Distrib.: Stem, petiole, leaf upper surface & margin (Fig. 167)

2.BICELLULAR CYLINDRICAL HAIR.

Foot: Simple. Body: 2-celled, entire, cells long, wide, cylindrical; tip obtuse; lateral walls slightly wavy, thin, smooth or rugose, constricted at joint; cross wall thick; lumen wide; content translucent. Distrib.: Petiole, leaf-margin (Fig.168).

3. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: 2-celled, entire, conical; cells longer than breadth, base wide ; tip obtuse; lateral walls thin, smooth, straight, swollen at joint; cross wall thin; lumen wide; content translucent. Distrib.: Stem, leaf (Fig.169).

4. BICELLULAR CURVED HAIR.

Foot: Simple. Body: 2-celled, entire, curved; cells longer than breadth, tapering, lower cell stout, upper cell curved ; tip obtuse; lateral walls thin, smooth, constricted at joint; cross wall thin; lumen wide; content translucent. Distrib.: Leaf-lower surface. (Fig.170)

5. BICELLULAR HOOKED HAIR.

Foot: Simple. Body: 2-celled, long, hooked; lower cell curved with wide base, upper cell long & conical; tip pointed; lateral walls thin, smooth, straight, joint swollen; cross wall thin; lumen wide; content translucent. Distrib.: Stem, petiole, leaf. (Fig. 171)

6. UNISERiate FILIFORM HAIR.

Foot: Simple Body: 3-8 celled, very long, filiform, cells longer than breadth, tubular, tip obtuse; lateral walls thin, smooth, straight; cross walls thin; lumen wide; content ^atranslucent. Distrib.: Stem, petiole, leaf, calyx. (Fig.172).

7. UNISERiate ASEPTATE FLAGELLATE HAIR.

Foot: Simple. Body: 3 celled, differentiated; stalk 2-celled, base wide, cells oblong, lateral walls thin, smooth; cross walls thin; upper cell narrowly flagellated, conical shaped, tip pointed; wall thin; content ^atranslucent. Distrib.: Leaf-surface, calyx. (Fig.173).

8. UNISERiate SEPTATE FLAGELLATE HAIR.

Foot: Simple. Body: 3-12 celled, septate flagellate; cells geniculated, body variously shaped, uppermost cell very long & flexuous; tip obtuse; lateral walls thin, smooth, constricted at joints; cross walls thin; lumen narrow; content opaque. Distrib.: Corolla & stamen. (Fig.174).

9. UNISERiate CYLINDRICAL HAIR.

Foot: Simple. Body: 3-5 celled, entire, cylindrical; cells longer than breadth, tip obtuse; lateral walls thick, smooth; cross walls thick; lumen wide; content translucent. Distrib.: Petiole. (Fig.175).

10. UNISERiate HOOKED HAIR.

Foot: Simple. Body: 3-9 celled, hooked; cells oblong except the terminal longest conical cell, tip obtuse; lateral walls thin, smooth, constricted at joints; cross walls thin; lumen wide; content translucent. Distrib.: Stem, petiole, leaf. (Fig.176).

11 .UNISERiate FORKED HAIR.

Foot: Simple Body: 3-8 celled, long, forked, cells longer than breadth, terminal cell longest & deeply forked, lateral & cross walls thin, smooth; lumen wide; content translucent. Distrib.: Leaf upper surface. (Fig.177).

12. UNICELLULAR GLANDULAR CAPITATE HAIR..

Foot: Simple. Body: Differentiated; stalk 1-celled, short, rectangular, thin walled, content translucent; head 1-celled, large, globose, wall thin, content

granulated light green. Distrib. : Stem, petiole, leaf-upper surface. (Fig.178).

13. UNISERIAL GLANDULAR CAPITATE HAIR..

Foot: Simple. Body: Differentiated; stalk 3-celled, long, cells oval, thin walled, smooth, convex, constricted at joints, cross walls thin, lumen wide, content translucent; head 1-celled, oval, large, wall thin, content granulated light green. Distrib. : Leaf-lower surface & margin. (Fig.179)

VITEX CORIACEA

It shows ten type of trichomes. (Plate.10 Fig.180-189)

1. UNICELLULAR CONICAL HAIR.

Foot: Simple. Body: 1-celled, conical, cell longer than breadth, tapering to a pointed tip, walls thin, smooth, straight; lumen wide; content translucent. Distrib.: calyx. (Fig. 180)

2. UNICELLULAR HOOKED HAIR.

Foot: Simple. Body: 1-celled, hooked; cell narrowly

elongated, bent in mid region; tip pointed; walls thick, smooth; lumen narrow; content translucent. Distrib.: calyx. (Fig.181).

3.UNICELLULAR DENTATE HAIR.

Foot: Simple. Body: 1-celled, small, dentate; base wide; tip pointed; walls thick, smooth, straight; lumen wide; content translucent. Distrib.: Stem, & calyx. (Fig.182).

4.BICELLULAR FILIFORM HAIR.

Foot: Simple. Body: 2-celled, very long, filiform; upper cell very long, lower short, rectangular; tip pointed; lateral and cross walls thin, rugose straight; lumen wide; content translucent. Distrib.: corolla & stamen. (Fig.183)

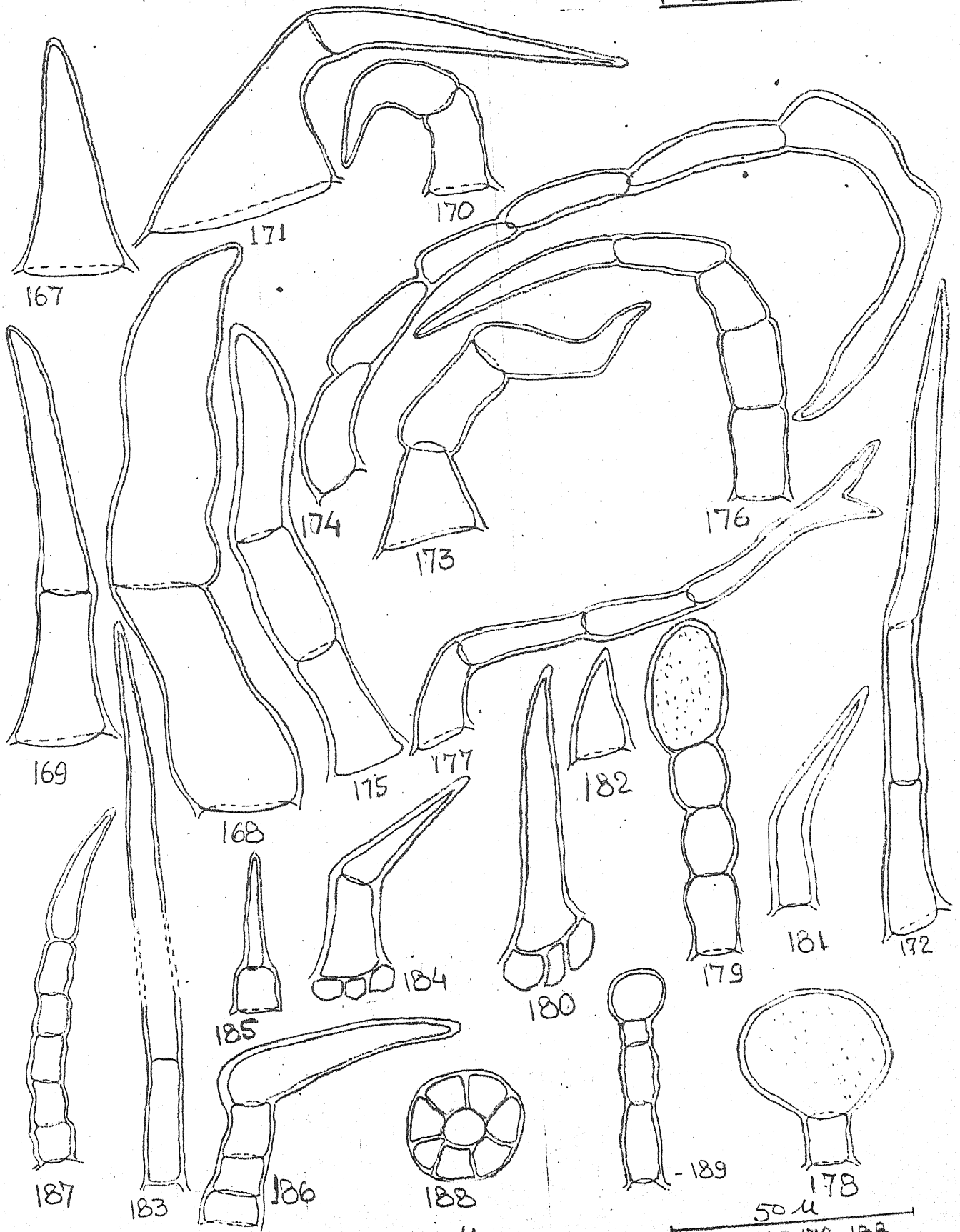
5.BICELLULAR HOOKED HAIR.

Foot: Compound. Body : 2-celled, entire, hooked; lower cell long, stout, rectangular; upper cell long & conical, bent at the Joint; tip pointed; lateral walls thick, smooth, straight; cross wall thin; lumen wide; content translucent. Distrib.: Stem & calyx. (Fig. 184)

Explanation of the figures of Plate 10.
Trichomes from various plant parts.

- | | | |
|-----------------------------|---|------------------------|
| Figs. 167-179 | : | <u>Vitex negundo.</u> |
| Figs. 167, 169,
172, 178 | : | Stem. |
| Figs. 168, 175 | : | Petiole. |
| Figs. 170, 173 | : | Leaf upper surface. |
| Figs. 171, 176, 179 | : | Leaf margin. |
| Figs. 174 | : | Corolla. |
| Fig. 177 | : | Leaf lower surface. |
| | | |
| Figs. 180-189 | : | <u>Vitex coriacea.</u> |
| Figs. 180, 181 | : | Calyx. |
| Figs. 182, 184, 188 | : | Stem. |
| Figs. 183, 186,
187, 189 | : | Corolla. |
| Fig. 185 | : | Staminal filament. |

PLATE-10



100 μ
184-187, 189

100 μ
172, 174-178, 180-182

50 μ
167-171, 173, 179, 188

6. BICELLULAR BELEMNOID HAIR.

Foot: Simple. Body: 2 celled, belemnoid; lower cell wide and short like dot; upper cell narrowly elongated, tapering to a pointed tip; lateral and cross walls thin, smooth, straight; lumen narrow; content translucent. Distrib.: Stamen. (Fig. 185).

7. UNISERiate HOOKED HAIR.

Foot: Simple. Body: 3-5 celled, differentiated, hooked; terminal cell longest, falcate, and seated typically on 3-4 celled short, cubical stalk; lateral walls thin, smooth; cross walls thin; lumen wide; content translucent. Distrib.: Stem, corolla. (Fig. 186).

8. UNISERiate TORRULOSE HAIR.

Foot: Simple. Body: 3-8 celled, torrulose, cells short, rectangular, except upper most conical cell, tip pointed; lateral and cross walls thin, smooth; constricted at Joints; lumen wide; content translucent. Distrib.: corolla. (Fig. 187).

9. PELTATE HAIR.

Foot: Not visible. Body: shield like, circular,

parallel to epidermis, 1 celled in thickness. 6-9 celled in diameter, cells cubical, arranged around the hollow center; outer and lateral walls thin, content translucent. Distrib.: Stem & calyx. (Fig.188).

10. UNISERIATE GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-4 celled, cells longer than breadth, except upper collar cell, lateral and cross wall thin & smooth, content translucent; head 1-celled, globose, thin walled, content light yellow. Distrib.: Corolla. (Fig.189).

VITEX : AGNUS CASTUS.

It shows six type of trichomes. (Plate.11 Fig.190-195)

1.UNICELLULAR PAPILLOSE HAIR.

Foot: Simple. Body: 1-celled, broad & long variously papillose; tip obtuse; walls thin, smooth, lumen wide; content translucent. Distrib.: Stem, petiole, leaf, inflaxis, bract, calyx, corolla. (Fig. 190)

2. UNICELLULAR HOOKED HAIR.

Foot: Simple. Body: 1-celled, hooked; cell base wide, cell longer than breadth; tip obtuse; walls thin, smooth; straight; lumen wide; content translucent. Distrib.: Leaflet upper surface & margin. (Fig.191).

3. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: 2-celled, long, erect, conical; cells longer than breadth, upper cell much longer than lower; tip acute; lateral walls thick, smooth, straight; lumen wide; content translucent. Distrib.: Stem, petiole, bract & corolla. (Fig.192).

4. BICELLULAR HOOKED HAIR.

Foot: Simple. Body: 2-celled, hooked; lower cell small curved with wide base, upper cell long; ; tip opaque; lateral walls thick, smooth, straight; cross wall thick; lumen wide; content translucent. Distrib.: Stem, petiole, leaf, Infl. axis, bract, calyx, corolla. (Fig.193)

5. UNISERIATE SEPTATE FLAGELLATE HAIR.

Foot: Compound. Body : 3-6 celled, long, flagellate;

cells varied in length and shape; tip opaque; lateral and cross walls thin, smooth; lumen wide; content translucent. Distrib.: Leaflet lower surface & margin, Infl. axis, bract & corolla. (Fig. 194)

6. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple Body: Differentiated; stalk 1 celled, rectangular, shorter than head, thin walled, content translucent; head large, capitate, glandular cells two, walls thin, content dense. Distrib.: Calyx. (Fig. 195).

VITEX SIAMICA.

There are twelve type of trichomes observed in this species (Plate. 11 Fig. 196-207)

1. UNICELLULAR PAPILLOSE HAIR.

Foot: Simple. Body: Entire, papillose; cell short; tip opaque; walls thin, rugose, straight; lumen wide; content translucent. Distrib.: Infl. axis & calyx. (Fig. 196)

2. BICELLULAR FILIFORM HAIR.

Foot: Simple. Body: 2-celled, short, filiform; cells

longer than breadth, tip Pointed; lateral walls thick, rugose, straight, Joint distinct; cross wall thin; lumen narrow; content opaque. Distrib.: Stem, Infl-axis, calyx. (Fig.197).

3. BICELLULAR ASEPTATE FLAGELLATE HAIR.

Foot: Simple. Body: 2-celled, flagellate, differentiated; lower cell short, rectangular; upper cell narrowly elongated, flexuous; tip obtuse; lateral walls thin, rugose, wavy; lumen narrow; content opaque. Distrib.: Calyx, corolla. (Fig.198).

4. BICELLULAR CURVED HAIR.

Foot: Simple Body: 2-celled, entire, cylindrical; cells of varied length, lower cell short, wider than long, upper cell elongated, tip obtuse; lateral walls thin, rugose; lumen wide; content translucent. Distrib.: Stamen (Fig.199)

5. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: 2-celled, long, conical cells of varied length, upper cell long & tapering, lower cell short and rectangular; tip acute ; lateral and cross walls thin, rugose; lumen wide; content translucent.

Distrib.: calyx, corolla, Stamen. (Fig. 200)

6. BICELLULAR HOOKED HAIR.

Foot: Simple. Body: 2 celled, entire, hooked; cells of varied length, lower cell small upper cell elongated, tapering to a pointed tip; lateral and cross walls thin, rugose, straight; lumen wide; content opaque. Distrib.: Calyx and corolla. (Fig. 201).

7. UNISERiate SEPTATE FLAGELLATE HAIR.

Foot: Simple. Body: 3-4 celled, flagellate; cells narrowly elongated, terminal cell longest, flexuous; tip pointed; lateral and cross walls thin, rugose, wavy; lumen narrow; content opaque. Distrib.: Infl-axis, calyx & corolla. (Fig. 202).

8. UNISERiate CONICAL HAIR.

Foot: Simple. Body: 3-12 celled, short, erect, conical; cells longer than breadth, base wide, tapering; tip pointed; lateral walls thin, rugose; cross walls thin; lumen wide; content translucent. Distrib.: Corolla & stamen. (Fig. 203).

9. UNISERiate CURVED HAIR.

Foot: Simple. Body: 3-4 celled, curved; cells longer

then breath; tip pointed; lateral and cross walls thick, rugose; lumen narrow; content opaque. Distrib.: Infl-axis, calyx, & corolla. (Fig.204).

10. UNISERIATE HOOKED HAIR.

Foot: Simple. Body: 3-4 celled, small, hooked; cells narrowly hooked, base wide, curved; tip pointed; lateral walls thick, rugose, straight; cross walls thin; lumen narrow; content opaque. Distrib.: Infl-axis, calyx. (Fig.205).

11. PELTATE HAIR.

Foot: Not visible. Body : Multicellular, shield like, circular, parallel to epidermis, 1-celled in thickness, 5-9 celled in diameter, cells radiating from hollow center, outer and lateral wall thin, content translucent. Distrib.: Infl.axis, calyx, corolla & ovary wall. (Fig.206).

12. UNICELLULAR GLANDULAR CAPITATE HAIR..

Foot: Simple. Body: Differentiated; stalk 1-celled, lower cell prominent, upper cell short, collared, rectangular, walls thin, smooth, content translucent; head large, globose, thin walled, content light brown. Distrib. : Corolla, stamen. (Fig.207)

CLERODENDRON FRAGRANS

It shows four type of trichomes. (Plate.11 Fig.208-211)

1. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: 2-celled, conical; upper cell elongated, tapering, lower cell wide, dome shaped; tip pointed; lateral walls thin, smooth, straight, constricted at Joint; cross wall thin; lumen wide; content translucent. Distrib.: Leaf. (Fig.208).

2. UNISERiate CONICAL HAIR.

Foot: Simple. Body: 3-12 celled, entire, long, conical; cells of varied length, terminal cell very long & tapering; tip pointed; lateral and cross walls thick, smooth, constricted at distinct Joints; lumen wide; content translucent. Distrib.: Stem, petiole, leaf. (Fig.209).

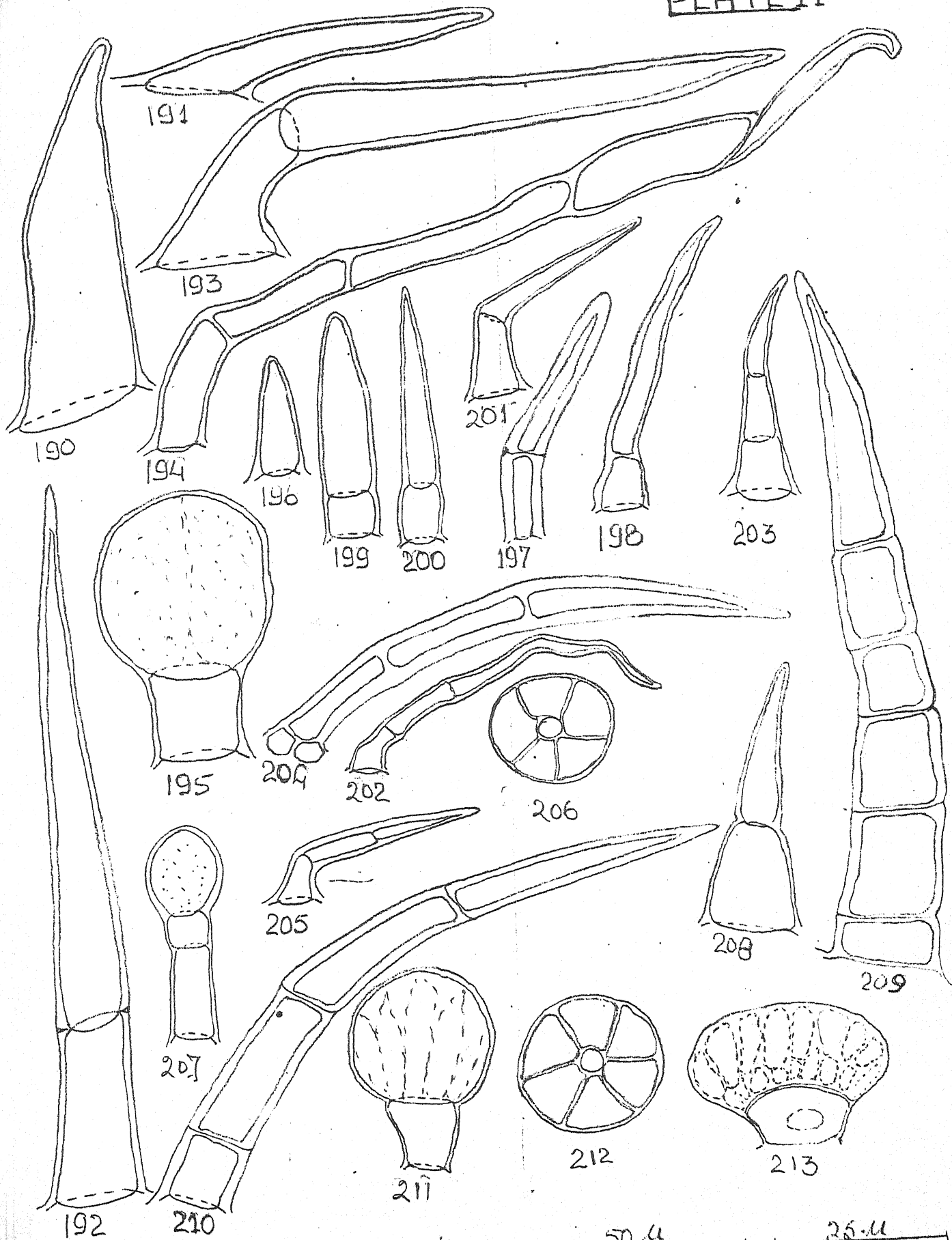
3. UNISERiate CURVED HAIR.

Foot: Simple. Body: 3-12 celled, entire, very long, curved; cells of varied length & longer then breadth; basal cell short; tip pointed; lateral and cross

Explanation of the figures of Plate 11.
Trichomes from various plant parts.

- Figs. 190-195 : Vitex agnus-castus.
- Figs. 190, 192, 193 : Stem.
Figs. 191 : Leaflet lower.
Figs. 194 : Leaflet upper.
Figs. 195 : Calyx.
- Figs. 196-207 : Vitex siamica.
- Figs. 196, 204, 205, : Infl. axis.
Figs. 197, 206 : Stem.
Figs. 198, 200, 201, : Calyx.
202, 203
- Fig. 199 : Stamenal filament.
Fig. 207 : Corolla.
- Figs. 208-211 : Clerodendron fragrans.
- Fig. 208 : Leaf lower surface.
Figs. 209, 210 : Stem.
Fig. 211 : Petiole.
- Figs. 212-213 : Clerodendron indicum.
- Fig. 212 : Leaf upper surface.
Fig. 213 : Bract.

PLATE-11



100 μ
199-203, 205, 206, 211

50 μ
194, 196, 208-210

50 μ
191, 93, 97, 98, 204, 7, 12, 13

25 μ
190, 92, 95

walls thick, smooth; lumen wide; content translucent.
Distrib.: Petiole & leaf. (Fig.210).

4. UNICELLULAR GLANDULAR CAPITATE HAIR..

Foot: Simple. Body: Differentiated; stalk 1-celled, short, clavate, walls thin, smooth, content translucent; head large, globose, glandular cells many, arranged length wise, outer wall thin, prominent, lateral walls thin, hyaline, content opaque. Distrib. : Stem, petiole, leaf-surface. (Fig.211)

CLERODENDRON INDICUM

It shows only two type of trichomes. (Plate.11 Fig.212-213)

1. PELTATE HAIR.

Foot: Not visible. Body : Multicellular, shield like, circular, parallel to epidermis, 1-celled in thickness, 6-8 celled in diameter, cells radiating from hollow center, cells triangular, outer and lateral wall thin, content dense. Distrib.: Leaf-surface, infl. axis, bract & calyx. (Fig.212).

2. UNICELLULAR GLANDULAR CAPITATE HAIR..

Foot: Simple. Body: Differentiated; stalk 1-celled, short, wider than length, walls thin, smooth, lumen wide, content translucent; head large, inflated, over stalk like cap, glandular cells many and of varied shape, hyaline, content granulated dense. Distrib. : Bract & calyx. (Fig.213)

CLERODENDRON INERME

It shows nine type of trichomes. (Plate 12 fig. 214-222)

1. UNICELLULAR CONICAL HAIR.

Foot: Simple. Body: 1-celled, entire, elongated, conical; cell longer than breadth; tip pointed; walls thin, smooth, straight; lumen wide; content translucent. Distrib.: corolla and stamen. (Fig. 214)

2. UNICELLULAR CURVED HAIR.

Foot: Compound. Body: 1-celled, short, curved; tip

obtuse or pointed; wall thin or thick, rugose; lumen wide; content opaque. Distrib.: Stem, petiole, leaf lower surface & margin, calyx. (Fig.215).

3. UNICELLULAR DENTATE HAIR.

Foot: Compound. Body: 2-celled, hyaline, flagellate; cell small, longer than breadth, flexuous; tip obtuse; lateral & cross walls thin, rugose; lumen wide; content opaque. Distrib.: Stem, petiole. (Fig.216).

4. BICELLULAR CONICAL HAIR.

Foot: Simple Body: Entire, elongated, conical; lower cell shorter and rectangular; upper cell large & conical; tip obtuse; lateral walls thick, rugose straight; swollen at joint; cross wall thin, lumen wide; content opaque. Distrib.: Stem, petiole, leaf-surface, calyx. (Fig.217)

5. BICELLULAR HOOKED HAIR.

Foot: Simple. Body : Entire, elongated conical; lower cell short and rectangular; upper cell large & conical; tip obtuse; lateral walls thick, rugose, straight, swollen at joint; cross wall thin; lumen

wide; content opaque. distrib; Stem, petiole, leaf-surface, calyx (Fig. 217)

6. UNISERiate CURVED HAIR.

Foot: Simple. Body: 3-4 celled, entire, elongated, curved ; cells longer than breadth; tip pointed or obtuse; lateral walls thick, rugose, joint distinct and swollen; cross walls thick; lumen narrow; content opaque. Distrib.: Stem. petiole, leaf lower surface & calyx. (Fig. 219).

7. UNISERiate HOOKED HAIR.

Foot: Compound. Body: 3-4 celled, entire, hooked; base bulbous, cells oval and longer than breadth; tip pointed or obtuse; lateral walls thick, rugose, constricted at joints, convex; cross walls thick; lumen narrow; content opaque. Distrib.: Stem, petiole, leaf. (Fig. 220).

8. PELTATE HAIR.

Foot: Not visible. Body: Shield Like, circular. parallel to epidermis. 1 celled in thickness, 5-7 celled in diameter, cells rectangular or triangular

in shape; radiating from the centre, walls thin, hollow center, content opaque. Distrib : Stem, petiole, leaf surface, calyx, corolla. (Fig 221).

9. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1 celled, short, wider than long, thin & smooth walled, lumen wide, content translucent; head 1 celled, large, globose, walls thick, prominent, content light yellow granulated. Distrib : Corolla. (Fig. 222).

CLERODENDRON INFORTUNATUM

It shows eight type of trichomes. (Plate 12 Fig. 223-230)

1. UNICELLULAR PAPILLOSE HAIR..

Foot : Simple. Body : Dwarf, hyaline, papillose; cell domed; tip obtuse; walls thin, smooth, convex; lumen wide; content translucent. Distrib. : Leaf-lower surface, calyx & corolla. (Fig. 223)

2. BICELLULAR CONICAL HAIR..

Foot : Simple. Body : 2 celled, long, wide, conical;

cells longer than breadth, upper cell long and tapering; tip obtuse or pointed; lateral wall thin, rugose; cross walls thick; lumen wide, content translucent. Distrib. : Leaf, calyx, corolla. (Fig 224)

3. UNISERiate FILIFORM HAIR..

Foot : Simple. Body : 6-28 celled, entire, very much elongated, filiform; cells of varied length; tip obtuse; lateral and cross walls thin, rugose, straight, constricted at joints; lumen narrow or wide; content translucent. Distrib. : Stem, leaf (Fig. 225)

4. UNISERiate ASEPTATE FLAGELLATE HAIR..

Foot : Simple. Body : 3-12 celled, long, differentiated, basal cell much wider, erect, cells longer than breadth, and cross walls thin, rugose; head 1- celled, long, flagellate, tip pointed, walls thin; lumen wide; content translucent. Distrib. : Leaf surface (Fig. 226)

5. UNISERiate CONICAL HAIR..

Foot : Simple. Body : 3-8 celled, entire, conical; cells of varied length and shapes, base broad; tip

pointed; lateral walls thick, rugose, straight, constricted at joints; cross walls thin; lumen wide; content translucent. Distrib. : leaf, calyx, corolla (Fig. 227)

6. UNISERiate CURVED HAIR..

Foot : Simple. Body : 3-8 celled, entire, curved; cells longer than breadth; tip pointed; lateral and cross walls thin, rugose; lumen wide; content translucent. Distrib. : Leaf, calyx, corolla (Fig. 228)

7. PELTATE HAIR..

Foot : Not visible. Body : Shield like, circular in shape, parallel to epidermis, 1- celled thick, 9-12 celled in diameter; cells longer & radiating elongated, center hollow, outer wall thin, smooth, lateral walls thin, hyaline, content translucent. Distrib. : Stem, leaf-surface, calyx, corolla (Fig. 229)

8. BICELLULAR GLANDULAR CAPITATE HAIR..

Foot : Simple. Body : Differentiated; stalk 2-celled, erect, cells short, rectangular, lateral and cross walls thin, walls thin, content translucent;

head large, capitate, globose, glandular cells many, arranged lengthwise, walls thin, hyaline, content light yellowish. Distrib. : Stem, leaf surface, calyx, corolla (Fig. 230)

CLERODENDRON PENICULATUM

There are eight type of trichomes observed in this plant. (Plate 12 Fig. 231-239)

1. UNICELLULAR CONICAL HAIR..

Foot : Simple. Body : 1-celled, long, entire, conical, tip pointed, walls thin, smooth,, straight ; lumen wide, content translucent. Distrib. : Corolla & stamen. (Fig. 231)

2. UNICELLULAR HOOKED HAIR..

Foot : Compound. Body : 1- celled, arrect, hooked; base wide; tip pointed; walls thin, rugose; lumen wide : content translucent. Distrib. : Stem. leaf-margin. (Fig. 232)

3. UNICELLULAR DENTATE HAIR..

Foot : Compound. Body : 1- celled, entire, short, dentate; cell longer than breadth, base wide; tip pointed; walls thin rugose, straight ; lumen wide;

content translucent. Distrib. : Stem, petiole, leaf lower surface, calyx, corolla. (Fig. 233)

4. BICELLULAR ASEPTATE FLAGELLATE HAIR..

Foot : Simple. Body : 2- celled, differentiated; 1 stalk short, cell longer than breadth, wall thick, rugose : upper cell narrowly flagelled, lateral and cross walls thin, rugose; lumen narrow; content opaque. Distrib. : Infl. axis. (Fig. 234)

5. BICELLULAR HOOKED HAIR..

Foot : Compound Body : 3 celled, entire, hooked; cells longer than breadth; tip pointed; lateral and cross walls thin or thick, rugose, swollen at joint; lumen wide; content translucent. Distrib. : Stem, petiole, leaf, calyx. (Fig. 235)

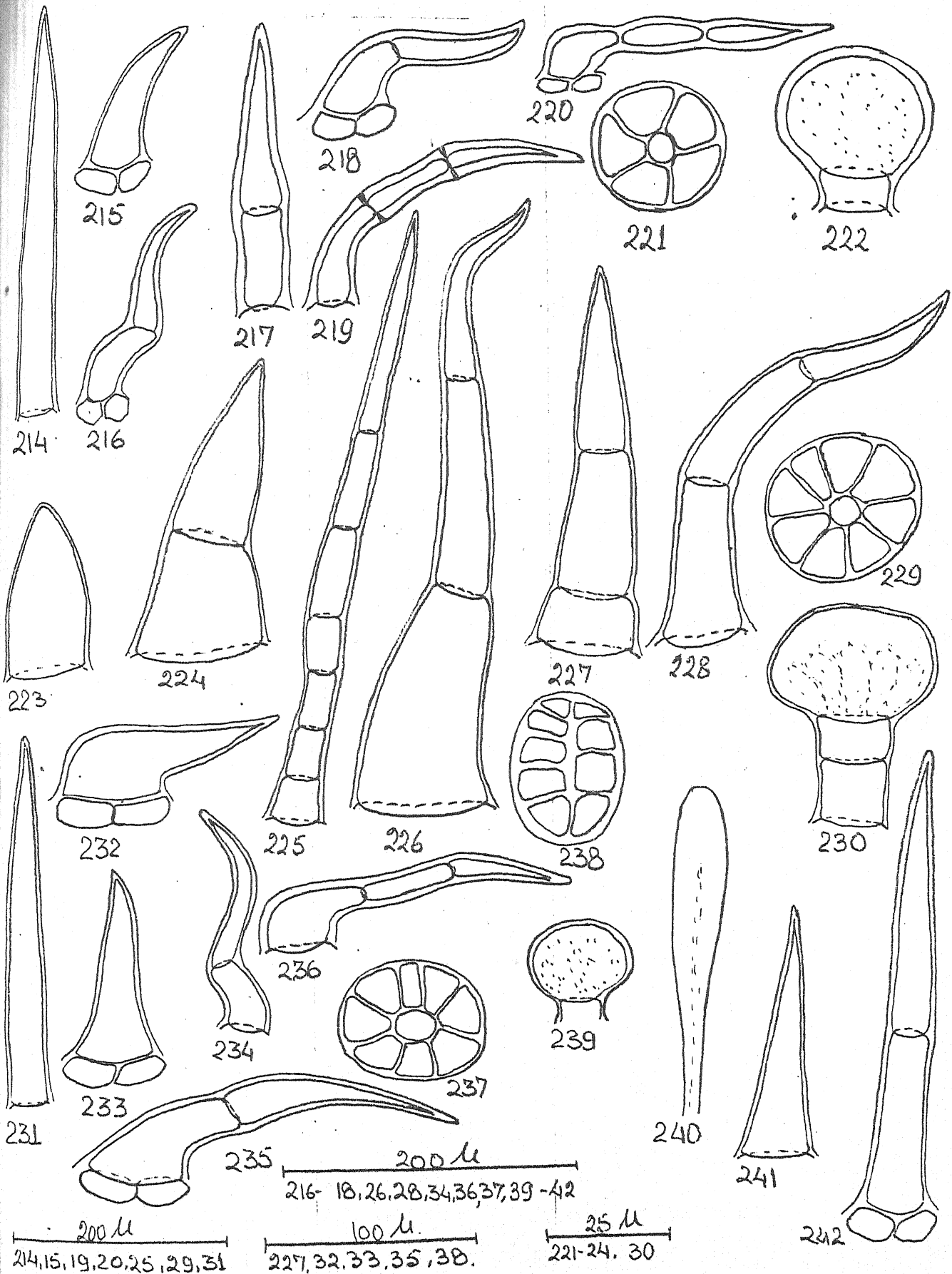
6. UNISERIATE HOOKED HAIR..

Foot : Simple. Body : 3 celled, entire, hooked; cells longer than breadth, basal cell curved with wide base; tip pointed; lateral and cross walls thick, rugose; lumen narrow or wide; content opaque. Distrib. : Stem, petiole, leaf lower surface & margin, calyx. (Fig. 236).

Explanation of the figures of Plate 12.
Trichomes from various plant parts.

- Figs. 214-222 : Clerodendron inerme.
- Figs. 214, 222 : Corolla.
Figs. 215, 216, 217, : Stem.
218, 221
- Fig. 219 : Petiole.
Fig. 220 : Leaf upper surface.
- Figs. 223-230 : Clerodendron infortunatum.
- Figs. 223, 224 : Calyx.
Figs. 225, 229, 230 : Stem.
Fig. 226 : Leaf upper surface.
Fig. 227 : Corolla.
- Figs. 231-239 : Clerodendron peniculatum.
- Fig. 231 : Corolla.
Figs. 232, 233, : Stem.
235, 237
- Fig. 234 : Infl. axis.
Figs. 236, 239 : Petiole.
Fig. 238 : Calyx.
- Figs. 240-242 : Clerodendron phlomidis.
- Figs. 240, 241 : Corolla.
Fig. 242 : Petiole.

PLATE-12



7. PELTATE HAIR..

FOOT : Not visible. Body : Multicellular, shield like, circular in shape, parallel to epidermis, 1-celled in thickness, cells of varied shape and size, arranged round the hollow center ((Fig. 237) or opposite to each other (Fig. 238), cells covered by thin smooth wall, content opaque. Distrib. : Fig. 237 - Stem, petiole, leaf surface, calyx, corolla, ovary; Fig. 238 - calyx.

8. UNICELLULAR GLANDULAR CAPITATE HAIR..

Foot : Simple. Body : Differentiated; 1 stalk 1-celled, very short, collared, rectangular, thin & smooth walled, lumen narrow, content translucent; head 1-celled, very large, globose, thin walled, content light yellow granulated. Distrib. : Petiole, leaf margin, calyx, corolla. (Fig. 239)

CLERODENDRON PHLOMIDIS

It shows thirteen type of trichomes (Plate 12- 13 Fig 240- 252)

1. UNICELLULAR PAPILLOSE HAIR..

Foot : Simple. Body : 1-celled, hyaline, papillose; cell very long; tip rounded; walls thin and smooth;

lumen wide; content translucent. Distrib. : Corolla, stamen. (Fig. 240)

2. UNICELLULAR CONICAL HAIR..

Foot : Simple. Body : 1-celled, long, entire, conical; cell longer than breadth, base wide; tip pointed or obtuse walls; thick rugose, straight; lumen wide or narrow; content translucent. Distrib. : Stem, petiole, leaf margin, calyx & corolla. (Fig. 241)

3. BICELLULAR CONICAL HAIR..

Foot : Compound. Body : Entire, long, conical; cells longer than breadth, tapering into pointed apex; lateral and cross walls thin, rugose, straight, lumen wide; content translucent. Distrib. : Petiole, leaf surface, bract, corolla. (Fig. 242)

4. BICELLULAR CURVED HAIR..

Foot: Compound. Body : 2- celled, entire, long curved; upper cell turn aside; tip pointed or obtuse; lateral & cross walls thin, rugose slightly swollen at joint; lumen wide; content translucent. Distrib. : Stem. leaf lower surface and margin, bract. (Fig. 243)

5. BICELLULAR HOOKED HAIR..

Foot : Compound. Body : Entire, hooked;; base wide, upper cell conical and narrow, cells longer than breadth; tip pointed; lateral and cross walls thick, rugose; lumen wide; content translucent. Distrib. : Stem, leaf. (Fig. 244)

6. UNISERiate FILIFORM HAIR..

Foot : Simple. Body : 3-8 celled, entire, cells longer than breadth; tip pointed; lateral and cross walls thin, rugose, straight, swollen at joints; lumen narrow; content translucent. Distrib. : Stem. petiole. leaf upper surface & margin, bract. (Fig.245)

7. UNISERiate ASEPTATE FLAGELLATE HAIR..

Foot : Simple. Body : 3-8 celled, differentiated, terminal cell flexuous and longest remains longer than breadth; lateral and cross walls thin, rugose; lumen wide; content translucent. Distrib. : Stem petiole, leaf, bract (Fig. 246)

8. UNISERiate SEPTATE FLAGELLATE HAIR..

Foot : Simple. Body: 3-6 celled, flagellate; cells flexuous, longer than breadth; tip pointed; lateral and cross walls thin, rugose: lumen wide; content

translucent. Disrib : Stem, petiole, leaf, bract.
(Fig. 247).

9. UNISERiate CURVED HAIR.

Foot: Simple. Body: 3-8 celled, curved; cells long, terminal cells much longer; tip pointed; lateral walls thin, rugose; cross walls thin; lumen wide; content translucent. Disrib; Stem, petiole, leaf, bract. (fig. 248)

10. UNISERiate FURCATE HAIR.

Foot: Simple. Body: Multicellular, uniseriate, revealing furcation of any one cell; cells much longer then breadth; tip pointed; lateral walls thick, smooth; cross walls thin; lumen narrow: content opaque. Disrib: Bract (fig. 249)

11. PELTATE HAIR.

Foot: Not Visible. Body: Multicellular, shield like, circular, parallel to epidermis, 1- celled in thickness, 4-5 celled in diameter, cells variable in shape and irregular in arrangement, covered by vasiculate outer wall; wall thin and smooth; content granulated opaque. Distrib. : Calyx. (Fig. 250)

12. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 1-celled, short, collared, cells wider than long, thin walled, content translucent; head large, capitate, glandular cells two, arrange length wise, walls thin, content light yellow granulated. Distrib: Stem, petiole, leaf surface, bract, calyx. (Fig.251)

13. UNISERiate GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 3 celled, upper cell short, cubical, lower cells longer than breadth, thin walled, content translucent or light yellowish; head 1-celled, capitate, thin walled, content light yellow. Distrib.: Corolla. (Fig.252)

CLERODENDRON MULTIFLORUM

It shows eight type of trichomes. (Plate 13 Fig.253 - 260)

1. BICELLULAR HOOKED HAIR.

Foot : Simple. Body : 2 celled, entire, hooked; cells wide, longer than breadth, upper cell conical and bent aside; tip pointed; lateral and cross walls thin, smooth or rugose, swollen at Joint; lumen wide;

content translucent. Distrib. : Petiole, leaf surface (Fig. 253)

2. UNISERiate FILIFORM HAIR.

Foot : Simple. Body : 3-6 celled, entire, long, filiform, cells of varied length, terminal cell longest; tip obtuse; lateral and cross walls thin, rugose, constricted at Joints. lumen wide; content opaque. Distrib. : Petiole, Infl. axis, bract, corolla. (Fig. 254)

3. UNISERiate SEPTATE FLAGELLATE HAIR.

Foot : Simple. Body : 3-4 celled. flagellate; cells longer than breadth, basal cell oblong, wider than the rest, terminal cell hyaline, flexuous; lumen wide; content translucent. Distrib. : Petiole, leaf, Infl.axis, bract. (Fig. 255)

4. UNISERiate CURVED HAIR.

Foot : Simple. Body : 3-5 celled, entire, curved; cells wide, longer than breadth; tip obtuse; lateral walls thick, smooth, straight, swollen at Joints; cross walls thin; lumen narrow; content opaque. Distrib. : Petiole, leaf, Inflaxis, bract (Fig.256)

5. PELTATE HAIR. .

Foot : Not Visible. Body : Shield like, circular in shape, parallel to epidermis, 1- celled in thickness, 5-6 celled in diameter; cells rectangular, radiating from hollow center; outer walls thin, smooth, cutinised, lateral walls thin, hyaline; content opaque. Distrib. Calyx, corolla. (Fig. 257)

6. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 1-celled, wider than long, content translucent; head 1- celled, large, globose, thin walled; content granulated yellow. Distrib. : Petiole, leaf surace, Infl.axis, corolla. (Fig. 258)

7. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 2 celled, upper short, cubical, lower prominently long, thin & smooth walled, content translucent; head 1-celled, large capitate, thin walled, content granulated yellowish. Distrib. : Calyx, corolla, Ovary wall. (Fig. 259)

8. UNISERIATE GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : 4-6 celled, differentiated; stalk 3-5 celled, erect, cells of varied length, thin walled, content translucent or light yellowish; head globose, large, consisting many long glandular cells, arrange lengthwise, walls thin, content light yellow granular. Distrib. : Corolla, ovary. (Fig. 260)

CLERODENDRON MULTIZUGA.

It shows eight type of trichomes in this plant. (Plate 13 & 14 Fig. 261-268)

1. BICELLULAR CONICAL HAIR.

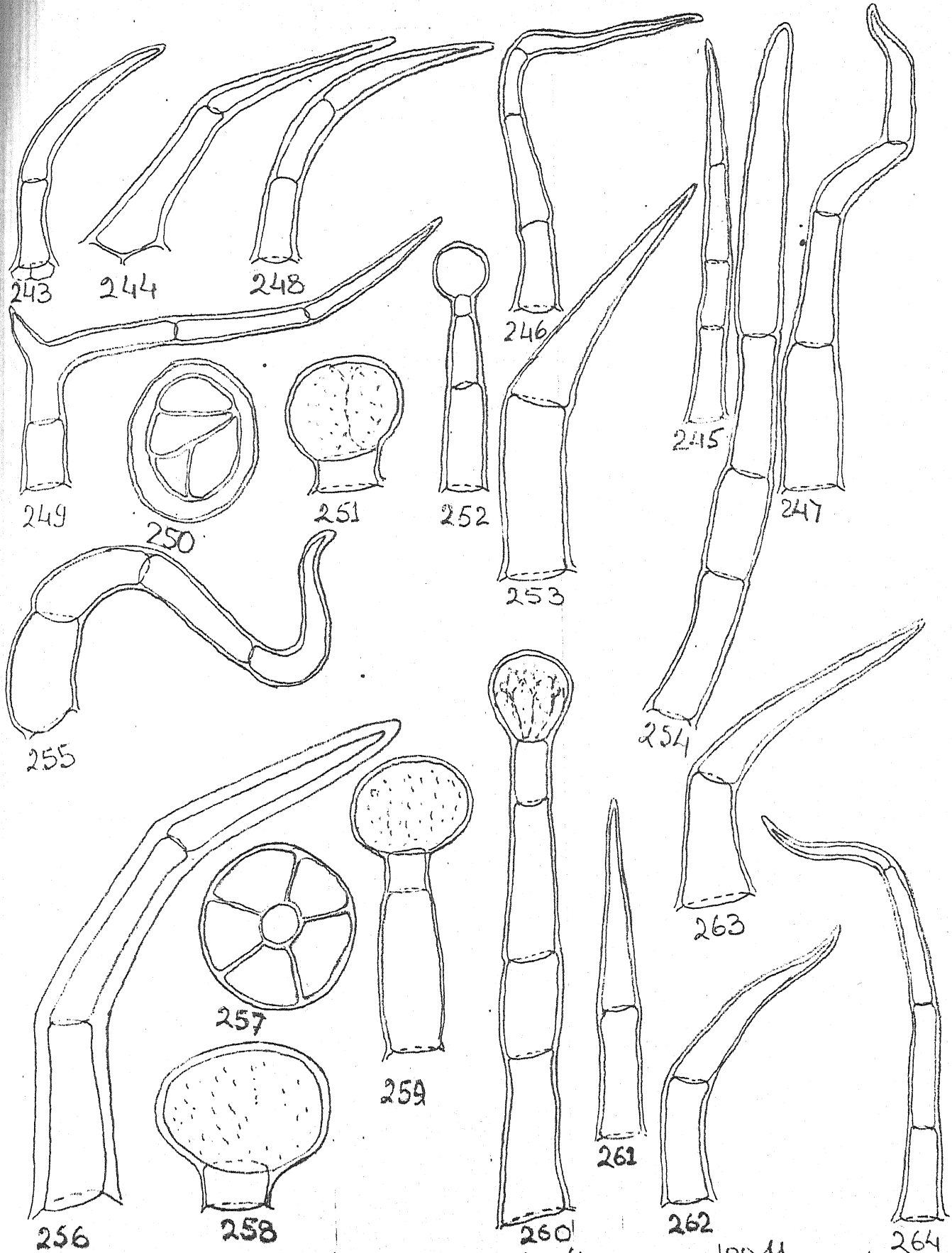
Foot : Simple. Body : 2-celled, elongated, straight, conical, cells long, rectangular, upper cell tapering into pointed apex, lateral and cross walls thin, rugose, straight, swollen at joint; lumen wide; content translucent. Distrib. : Petiole, leaf, Infl. axis, bract (Fig. 261)

2. BICELLULAR CURVED HAIR.

Foot : Simple. Body : Entire, long, curved; cells longer than breadth; tip pointed; lateral and cross

Explanation of the figures of Plate 13.
Trichomes from various plant parts.

Figs. 243-252	:	<u>Clerodendron phlomidis.</u>
Fig. 243, 245,	:	Stem.
246, 248	:	
Fig. 244	:	Leaf upper surface.
Figs. 247, 251	:	Petiole.
Fig. 249	:	Bract.
Fig. 250	:	Calyx.
Fig. 252	:	Corolla.
Figs. 253-260	:	<u>Clerodendron multiflorum.</u>
Figs. 253, 256,	:	Petiole.
258	:	
Fig. 254	:	Infl. axis.
Fig. 255	:	Leaf lower surface.
Fig. 257	:	Calyx.
Figs. 259, 260	:	Corolla.
Figs. 261-264	:	<u>Clerodendron multizuge.</u>
Fig. 261	:	Petiole.
Figs. 262, 263,	:	
264	:	Leaf upper surface.



100 μ 243, 47, 61

200 μ 244, 46, 48, 49, 52, 53, 62-64

25 μ 251, 57-59

100 μ 243, 50, 54-56, 60

walls thin, rugose, lumen wide; content translucent.
 Distrib.: Petiole, leaf upper surface, Infl. axis,
 bract, calyx. (Fig. 262)

3. BICELLULAR HOOKED HAIR.

Foot : Simple. Body : Entire, hooked; lower cell
 rectangular, upper long and tapering; tip pointed,
 lateral and cross walls thin, rugose, joint swollen,
 lumen wide; content translucent. Distrib: Petiole,
 leaf, infl. axis, bract. (Fig. 263)

4. UNISERiate ASEPTATE FLAGELLATE HAIR.

Foot : Simple. Body : 3-6 celled, differentiated;
 stalk 2-5 celled, cells narrow, longer than breadth;
 head 1 celled, narrowly flagellate: tip pointed;
 lateral and cross walls thin, rugose; lumen wide;
 content translucent. Distrib: Petiole,
 leaf, Infl. axis, bract (Fig. 264)

5. UNISERiate CONICAL HAIR.

Foot : Simple. Body : 3-4 Celled, entire, erect,
 conical; cells longer than breadth; tip pointed;
 lateral & cross walls thin, rugose, swollen at
 joints; lumen wide; content translucent; Distrib.:

leaf upper surface, margin, infl.axis, and bract.
(Fig.265)

6. UNISERiate CURVED HAIR.

Foot : Simple. Body : 3-6 celled, entire, curved;
cell longer than breadth, upper most cell tapering;
tip pointed; lateral & cross walls thin, rugose,
swollen at joints; lumen narrow or wide; content
translucent. Distrib: Stem. Petiole. leaf, Infl.axis,
bract. (Fig.266)

7. PELTATE HAIR.

Foot : Not visible. Body : Multicellular, shield like
, circular, 1-celled thick, parallel to epidermis,
cells of varied shape, arranged in one tier, inside
the common continised thick wall; content
translucent. Distrib. : calyx. (Fig. 267)

8. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 1-celled,
short, collared, thin walled, content translucent;
head 1-celled very large, globose, thin & smooth
walled, content light yellow. Distrib. : Petiole,
leaf surace, Inflaxis, bract & calyx. (Fig. 268)

CLERODENDRON SERRATUM

This plant have four type of trichomes (Plate 14 Fig. 269-272)

1. UNICELLULAR PAPILLOSE HAIR.

Foot : Simple. Body : 1-celled, dome shaped, papillose; tip obtuse; walls thin, rugose, convex; lumen wide; content translucent. Distrib.: Calyx & corolla. (Fig. 269)

2. UNISERiate FILIFORM HAIR.

Foot : Simple. Body : 3-6 celled, filiform; cells of varied length; tip obtuse; lateral and cross walls thin, rugose, straight; lumen wide; content opaque. Distrib.: Stem, bract, calyx. (Fig. 270)

3. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 1-celled, short, wider than long, thin & smooth walled, content translucent; head 1-celled, very large, globose, thin & smooth, walled, content granulated light green. Distrib.: Stem, leaf surface, bract & calyx. (Fig. 271)

4. UNISERIATE GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 2-4 celled, cells longer than breadth, except the collar cell, walls thin & smooth, content translucent except collar cell; head large, globose, glandular cells many, arranged lengthwise, inside the common periphery, walls thin, content light green yellow. Distrib.: Corolla (Fig. 272)

CLERODENDRON SPLENDENS

There are thirteen type of trichomes observed in this species. (Plate 14 Fig. 273-286)

1. UNICELLULAR HOOKED HAIR.

Foot : Simple. Body : 1-celled, short, hooked; cell slightly curved, longer than breath, tip pointed, walls thin, smooth; lumen wide; content translucent. Distrib.: Corolla. (Fig. 273)

2. BICELLULAR ASEPTATE FLAGELLATE HAIR.

Foot : Simple. Body : 2-celled, differentiated; lower cell stout, small erect, thin walled; upper cell very long, narrow and flagellated; tip pointed, lateral

walls thin, rugose; lumen narrow; content translucent. Distrib.: Petiole, leaf lower surface & margin. (Fig. 274)

3. BICELLULAR HOOKED HAIR.

Foot : Simple. Body : Entire, hooked; upper cell bend, conical, narrow; lower cell rectangular; tip pointed; lateral and cross walls thin, rugose, straight; lumen wide; content translucent. Distrib.: Stem, leaf, bract & corolla. (Fig. 275)

4. UNISERiate FILIFORM HAIR.

Foot : Simple. Body : 5-20 cells, filiform; cells of varied length and shape, upper most cell conical, tip obtuse or pointed; lateral & cross walls thin, rugose, constricted at joints; lumen wide; content translucent. Distrib. : Stem, petiole, leaf. (Fig. 276)

5. UNISERiate SEPTATE FLAGELLATE HAIR.

Foot : Simple. Body : 3-8 celled, flagellate; cells longer than breadth, flexuous; tip pointed; lateral walls thin, rugose ; lumen wide; content translucent. Distrib. : Stem, petiole; leaf, bract (Fig. 277)

6. UNISERiate CONICAL HAIR..

Foot : Compound. Body : 3-6 celled, entire, elongated, conical; cells long tip pointed; lateral and cross walls thick, rugose, straight, swollen at joints, lumen wide; content translucent. Disrib : Leaf-surface. (Fig. 278)

7. UNISERiate CURVED HAIR..

Foot : Compound. Body : 3-8 celled, entire, long, curved; cells longer than breadth; tip obtuse; lateral & cross walls thick, rugose; lumen narrow; content translucent. Distrib. : Petiole, bract. (fig. 279).

8. UNISERiate HOOKED HAIR.

Foot : Simple. Body : 3 celled, elongated, hooked; cells longer than breadth, tapering; tip pointed; lateral walls thick, rugose, swollen at joints; lumen wide; content translucent. Distrib : Leaf, bract (Fig. 280)

9. UNISERiate FURCATE HAIR.

Foot : Simple Body : 4-7 celled, uniseriate, intermediate cells reveals furcation; cells long &

narrow; tip pointed; lateral walls thin; lumen narrow; content translucent. Distrib. Bract (Fig. 281)

10. PELTATE HAIR.

Foot : Not Visible. Body: Shield like, circular, parallel to epidermis, 1-celled in thickness; 5-10 celled in diameter; cells rectangular, radiating from center; center hollow (Fig. 282) or cellular (Fig. 283) Distrib : Fig. 282-Leaf lower surface, bract, calyx, corolla Fig. 283-Calyx.

11. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple Body: Differentiated; stalk 1-celled, wider than long, thin walled, content translucent; head 1-celled, large, capitate, globose, walls thin and smooth, content light yellowish. Distrib : Stem, petiole, leaf surface, bract, calyx (Fig. 284)

12. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple Body: Differentiated; stalk 2-celled, lower cell large, prominent, longer than breadth; upper cell short, collared, walls thin & smooth, content translucent; head 1-celled, globose, thin & smooth wall, content light yellow. Distrib. : Corolla. (Fig. 285)

13. UNISERIATE GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; Stalk 2-4 celled, erect, gradually narrowing from wide base, cells longer than breadth, wall thin & smooth, content translucent; head 1-celled, rounded, thin walled, content light yellow. Distrib : Corolla. (Fig. 286)

HOLMSKIOLDIA SANGUINEA.

This plant shows fourteen type of trichomes (Plate 14 & 15 Fig 287-301)

1. UNICELLULAR PAPILLOSE HAIR.

Foot : Compound. Body : 1-celled, tubular, papillose, cell longer than breadth; tip rounded; walls thin, hyaline, smooth or rugose; lumen wide; content translucent. Distrib.: Stamen. (Fig. 287)

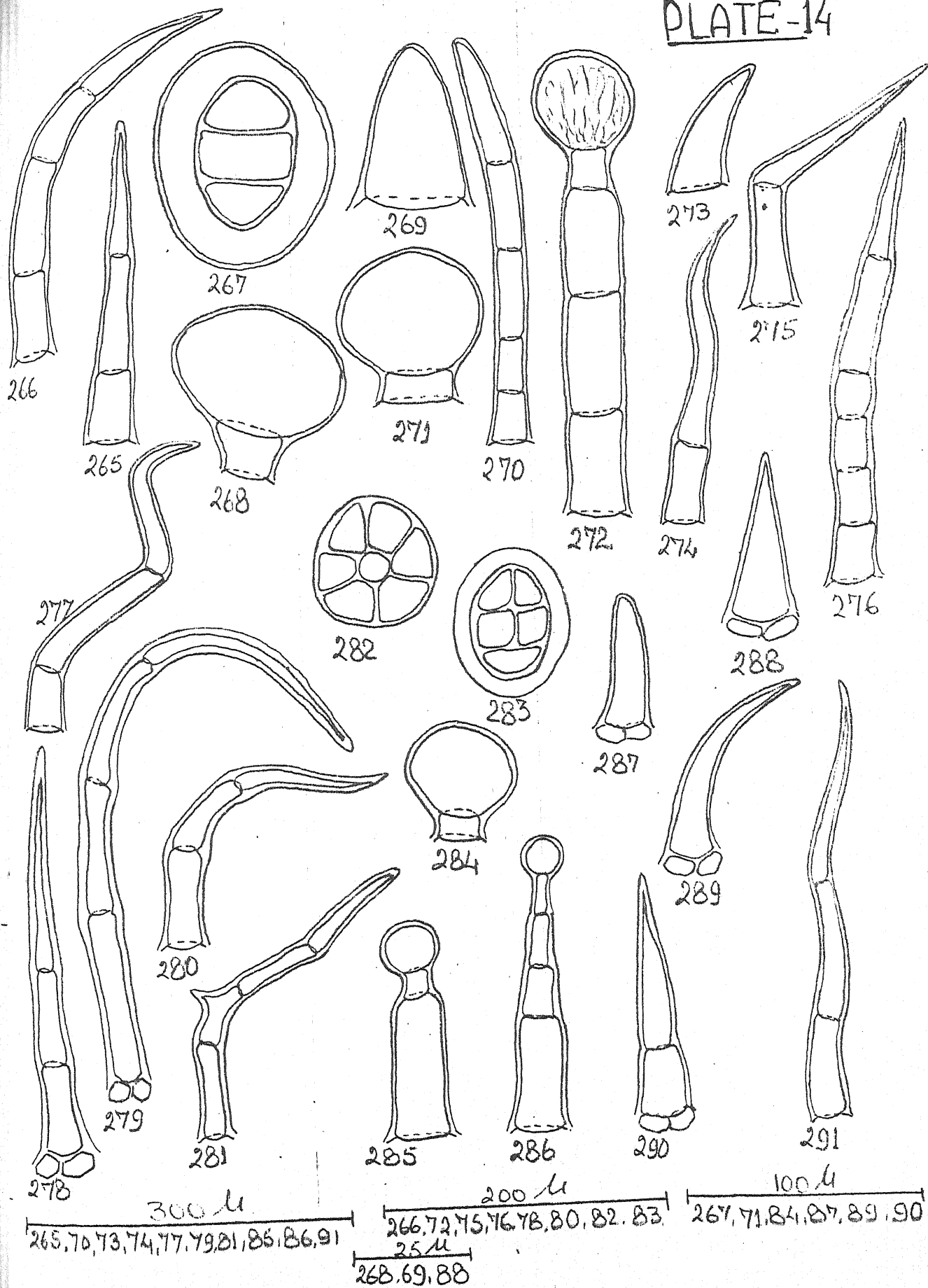
2. UNICELLULAR CONICAL HAIR.

Foot : Compound. Body : 1-celled, entire, conical: tip pointed: walls thin, rugose, straight; lumen

Explanation of the figures of Plate 14.
Trichomes from various plant parts.

- | | | |
|-----------------|---|--------------------------------|
| Figs. 265-268 | : | <u>Clerodendron multizuga.</u> |
| Fig. 265 | : | Leaf lower surface. |
| Fig. 266 | : | Stem. |
| Fig. 267 | : | Calyx. |
| Fig. 268 | : | Infl. axis. |
| | | |
| Figs. 269-272 | : | <u>Clerodendron sesratum.</u> |
| Figs. 269, 272 | : | Corolla. |
| Figs. 270, 271 | : | Stem. |
| | | |
| Figs. 273-286 | : | <u>Clerodendron splendens.</u> |
| Figs. 273, 285 | : | Corolla. |
| 286 | : | |
| Figs. 274, 277 | : | Petiole. |
| 279 | : | |
| Figs. 275, 276, | : | Stem. |
| 284 | : | |
| Figs. 278, 280, | : | Leaf upper surface. |
| 282 | : | |
| Fig. 281 | : | Bract. |
| Fig. 283 | : | Calyx. |
| | | |
| Figs. 287-291 | : | <u>Holmskioldia sanguinea.</u> |
| Fig. 287 | : | Staminal filament. |
| Figs. 288, 289, | : | Corolla. |
| 290 | : | |
| Fig. 291 | : | Petiole. |

PLATE-14



wide; content translucent. Distrib.: Corolla.(Fig. 288)

3. UNICELLULAR CURVED HAIR.

Foot : Compound. Body : 1-celled, entire, long, curved; cell narrow, longer than breadth; tip pointed; walls thin, rugose, turn aside; lumen narrow; content translucent. Distrib.: Corolla. (Fig.289)

4. BICELLULAR CONICAL HAIR.

Foot : Compound. Body : 2-celled, conical, lower cell shorter than upper, cells longer than breadth; tip pointed; lateral & cross walls thin, rugose, straight, constricted at joint; lumen wide; content translucent. Distrib.: Corolla.(Fig.290)

5. UNISERIATE SEPTATE FLAGELLATE HAIR.

Foot : Simple. Body : 3-8 celled, flagellate; cells longer than breadth, narrow, and flexuous; tip pointed; lateral and cross walls thin, rugose, joint swollen; lumen narrow; content translucent. Distrib.: Petiole, leaf upper surface, bract.(Fig.291)

6. UNISERiate ASEPTATE FLAGELLATE HAIR.

Foot : Simple. Body : 3-celled, flagellate, differentiated; Stalk 2 celled, erect, base wide, cells longer than breadth; head 1-celled, very long, narrowly flagellate; tip pointed; lateral & cross walls thin, rugose; lumen narrow; content translucent. Distrib.: Corolla. (Fig. 292)

7. UNISERiate CONICAL HAIR.

Foot : Simple. Body : 3-celled, entire, elongated, conical; tip pointed; lateral and cross walls thin, rugose; lumen narrow; content translucent. Distrib.: Leaf upper surface & Stamen. (Fig. 293)

8. UNISERiate CURVED HAIR.

Foot : Simple. Body : 3-4 celled, curved; basal cell wider than remains; tip pointed; lateral and cross walls thin, rugose; lumen narrow; content opaque. Distrib.: Stem, Petiole, leaf, bract. (Fig. 294)

9. UNISERiate HOOKED HAIR.

Foot : Simple. Body : 3-7 celled, entire, hooked; cells long, base wider than remains; tip pointed; lateral walls thick, rugose; cross walls thin; lumen

narrow; content opaque. Distrib. : Stem, petiole, leaf, bract, calyx. (Fig. 295)

10. UNISERiate ACERATE HAIR.

Foot : Simple . Body : 3-5 celled, long, acerate; cells longer than breadth; with swollen proximal end; tip pointed; lateral walls thin, irregular; cross walls thin; lumen varied; content translucent. Distrib. : Petiole, leaf upper surface. (Fig. 296)

11. UNISERiate FURCATE HAIR.

Foot : Simple . Body : 4-6 celled, uniseriate filiform; sub-basal cell revealing lateral furcation, cells long and narrow, terminal cell longest; tip pointed or obtuse; lateral and cross walls thin; lumen narrow; content translucent. Distrib. : Stem, bract. (Fig. 297)

12. PELTATE HAIR.

Foot : Not Visible. Body : Multicellular, Peltate (Fig. 298) or peltate Vascular (Fig. 299), shield like, circular, parallel to epidermis, 1-celled in thickness, 5-6 celled in diameter, outer walls thin,

cutinised, lateral wall thin, prominent, content opaque. Distrib. : Fig. 298-Stem, petiole, leaf surface, bract, calyx, corolla; Fig. 299 Petiole, leaf surface, bract, calyx, corolla, stamen, gynoe.

13. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Compound. Body : Differentiated; stalk 1-celled, long, rectangular, wall thin & smooth, content translucent; head 1-celled, large, globose, thin walled, content light yellow. Distrib. : Stamen. (Fig. 300)

14. UNISERIATE GLANDULAR CAPITATE HAIR.

Foot : Simple . Body : Differentiated; stalk 2-4 celled, cells rectangular, base wide, wall thin, smooth, content translucent; head 1-celled, large, globose, thin smooth walled, content light yellow. Distrib. : Petiole, bract, calyx, corolla. (Fig. 301)

CARYOPTERIS WALLICHIANA

This species shows eleven type of trichomes (Plate 15 Fig.302-312)

1. UNICELLUAR PAPILLOSE HAIR.

Foot : Simple . Body : 1-celled, entire, papillose,

conical, base wide; tip rounded; walls thin, smooth; lumen wide; content translucent. Distrib. : Stem, leaf lower surface & margin. (fig.302)

2. BICELLULAR FILIFORM HAIR.

Foot : Simple . Body : 2-celled, filiform, entire, cells long; tip obtuse; lateral & cross walls thin, smooth, joints swollen; lumen wide; content translucent. Distrib. : Stem, leaf lower surface. (fig 303)

3. BICELLULAR CYLINDRICAL HAIR.

Foot : Simple . Body : 2-celled, cylindrical, lower cell longer than breadth, rectangular, upper cell conical base wide; tip rounded; lateral and cross walls thin, smooth; lumen wide; content translucent. Distrib : Stem, leaf surface, calyx. (fig.304)

4. BICELLULAR HOOKED HAIR.

Foot : Simple . Body : 2-celled, entire, hooked, cells longer than breadth, upper cell conical; tip pointed; lateral walls thin, convex, smooth, swollen at joint; cross wall thin; lumen wide, content translucent. Distrib: Stem, leaf lower surface and

margin & calyx. (fig.305)

5. UNISERiate SEPTATE FLAGELLATE HAIR.

Foot : Simple . Body : 3-10 celled, entire, long, septate flagellate, cells of variable length, tip obtuse or pointed lateral & cross walls thin, smooth, not straight, lumen narrow. Distrib. : Stem, petiole, calyx. (Fig. 306)

6. UNISERiate HOOKED HAIR.

Foot : Simple . Body : 3-6 celled, hooked, cells swollen at base, articulated, uppermost cell conical and tapering in a pointed tip, lateral walls thin, smooth; cross walls thick, joints swollen; lumen wide; content translucent. Distrib: Stem, leaf, calyx. (fig.307)

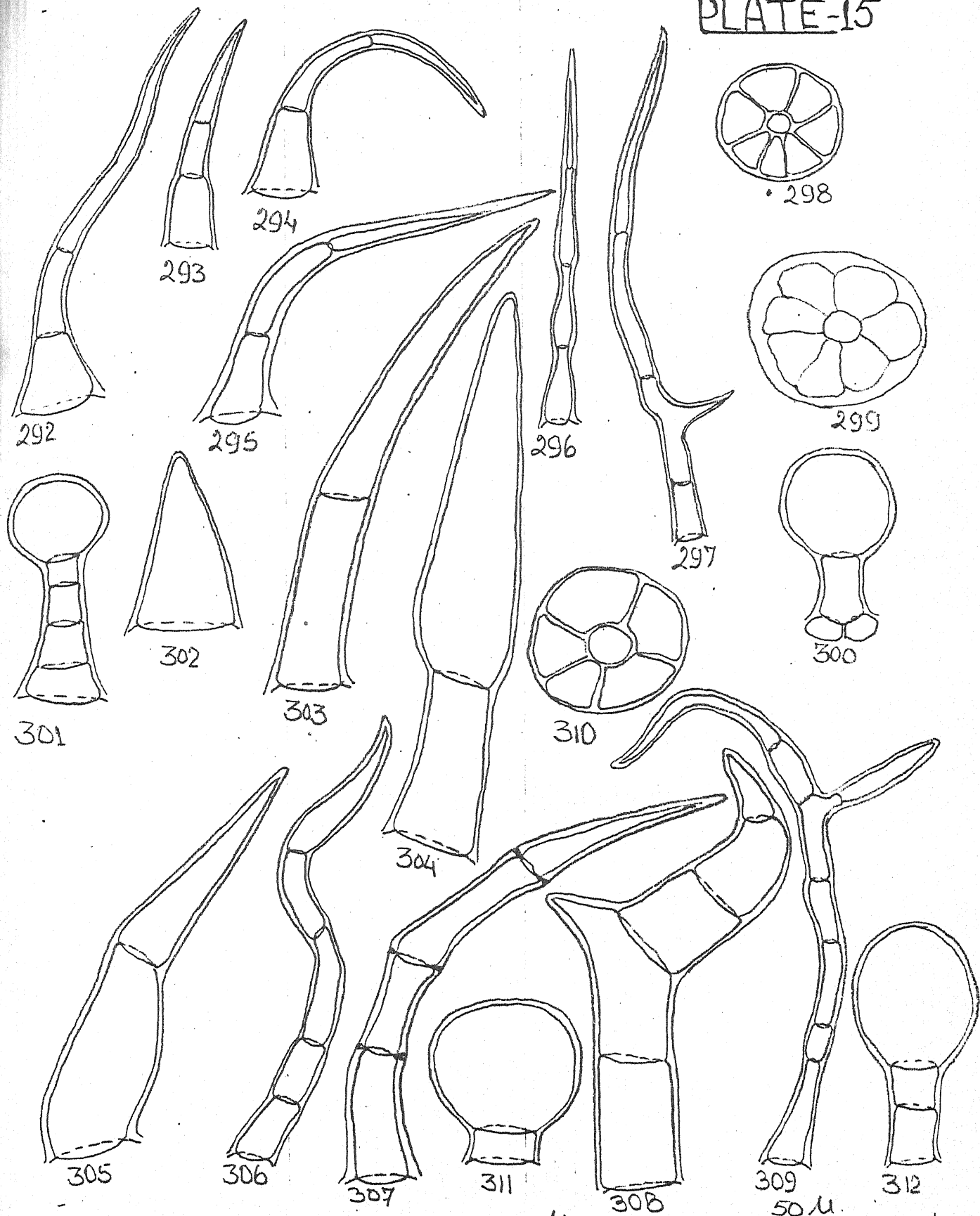
7. UNISERiate FURCATE HAIR.

Foot : Simple . Body : 5-8 Celled, stalk 1 to 2 celled, erect, wide, furcated, cells much longer than breath; tip pointed, lateral & cross walls thin, smooth, straight or curved; lumen wide, content translucent. Distrib.:Stem, leaf lower .(Fig.308)

Explanation of the figures of Plate 15.
Trichomes from various plant parts.

Figs. 292-301	:	<u>Holmskioldia sanguinea.</u>
Fig. 292	:	Corolla.
Figs. 293, 294, 295	:	Leaf lower surface.
Figs. 296, 299, 301	:	Petiole.
Figs. 297, 298	:	Stem.
Fig. 300	:	Staminal filament.
Figs. 302-312	:	<u>Caryopteris wallichiana.</u>
Figs. 302, 303, 304, 307, 308, 312	:	Stem.
Figs. 305, 310	:	Leaf upper surface.
Figs. 306, 309 311	:	Petiole.

PLATE-15



100 μ
293, 96, 97, 309

100 μ
292, 94, 95, 307

100 μ
299, 303, 5, 6, 8

50 μ
298, 300, 1, 2, 4, 10-12

8. UNISE^RATE BRANCHED HAIR.

Foot : Simple. Body : Multicellular, uniseriate, branched, branching from the base, diving cell protude out laterally than divide; tip obtuse or pointed; lateral & cross walls thin, smooth; lumen wide; content translucent. Distrib. : Petiole & calyx. (Fig. 309)

9. PELTATE HAIR.

Foot : Not visible. Body: Shield like, circular, parallel to epidermis, 1-celled in thickness, 5-7 celled in diameter; cells rectangular, radiating from center, center hollow, outer wall thin, smooth; lateral wall thin, hyaline, content translucent. Distrib.: Leaf lower surface & calyx. (Fig. 310)

10. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 1-celled, short rectangular, wall thin & smooth; content translucent; head 1-celled, large, globose, thin & smooth walled, content light yellow. Distrib.: Stem, petiole, leaf lower surface & calyx. (Fig. 311)

11. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple, Body : Differentiated; stalk 2-celled, upper cell short; lower long, cells longer than breadth, rectangular, walls thin & smooth, content translucent; head 1-celled, large, capitate, globose, wall thin, smooth, content light yellow. Distrib.: Stem, calyx. (Fig. 312)

B. OBSERVATION AND DISCUSSION

In the present investigations 35 species belonging to 15 genera of the family Verbenaceae were selected, and the trichomes were observed on the vegetative as well as floral parts. The study revealed a total number of 38 types of trichomes of both Non glandular (34 types) and Glandular (4 type) categories. Among the Non- glandular forms Uniseriate types are more abundant (13 type) followed by Unicellular (10 type) and Bicellular hairs (7 type). Stellate types are represented by 2 type and one type of each Dendroid and Peltate. Glandular forms are represented by Unicellular glandular capitate, Bicellular glandular capitate, Uniseriate glandular capitate and Dendriod glandular capitate, (Table III)

Organographic distribution of these trichomes is given in the table IV, their specieswise distribution in the table V and distribution of trichomes on

different parts of plant in the family Verbenaceae in table VI.

From the category of Non glandular form of hairs the most common types recoded are Peltate in 19 species, Unicellular papillose and Uniseriate hooked each in 16 species; Unicellular hooked in 15 species; Bicellular conical in 12 species, Unicellular flagellate and Uniseriate septate flagellate in 11 species; Uniseriate curved in 10 species; Unicellular curved, Bicellular aseptate, flagellate, Uniseriate filiform, Uniseriate conical, each in 8 species; Bicellular cylindrical, Uniseriate furcate each in 7 species; Bicellular filiform, Uniseriate aseptate flagellate each in 6 species; Bicellular curved in 5 species; Unicellular acerate, Unicellular dentate each in 4 species; Unicellular acuminate, Dendroid each in 3 species; Unicellular torulose, Bicellular belemnoid, Uniseriate cylindrical, Uniseriate branched, Uniseriate torulose & stellate multiradiate each in 2 species. Some forms are restricted in occurrence and are recorded only in one species viz., Unicellular dolebrate forms in Petrea volubilis, Uniseriate acerate in Holmskioldia

sanguinea, Uniseriate acuminate in Premna wightiana, Uniseriate falcate in Durenta plumieri, stellate triradiate in Callicarpa lanata.

Among the Glandular forms Uniseriate glandular capitate type is most common and is recorded in 26 species. Whereas, Bicellular glandular capitate in 16 species, Uniseriate glandular capitate in 15 species; Dendroid glandular capitate type in 2 species i.e. Callicarpa lanata, & Tectona grandis. In some species no Glandular type of trichomes are observed as in Nyctanthes arbor-tristis and verbena officinalis (Table V).

Trichomic significance has been established by the contribution of many workers. In present investigations also trichomes play an important role in taxonomic delimitation of different taxa of the family Verbenaceae under consideration. Two species of Lantana i.e. L. Camara and L. indica are similar in having common form of hairs i.e. Unicellular papillose, Unicellular conical, Unicellular hooked and Unicellular glandular capitate types. The former

differ from the latter species possessing Unicellular flagellate and Bicellular glandular capitate types. Further in L. camara Unicellular papillose, Unicellular curved, Unicellular hooked along with common types, Unicellular conical and Uniseriate glandular capitate types are observed on corolla, while in L. indica presence of Unicellular flagellate and Bicellular glandular capitate hairs recorded on stamens and show taxonomic importance.

Petrea Volubilis which is placed in between Lantana indica and Lippia geminata in the present study, shows great similarity with these two in possessing Unicellular papillose, Unicellular flagellate, Unicellular conical, Unicellular hooked and Bicellular glandular capitate forms (Table IV & V). Further P. volubilis stands quite distinct from the rest in having Unicellular flagellate, Bicellular filiform, Bicellular glandular capitate and Uniseriate glandular capitate forms of hairs on the corolla.

Both the species of Lippia i.e. L. geminata and L. nodiflora considered in present study, appear similar in having Unicellular conical and Unicellular

glandular capitate hairs. In view of the organographic distribution of trichomic structure and other additional forms, these taxa are also quite distinctive as the former species possesses Unicellular papillose, Unicellular flagellate, Unicellular curved, Unicellular hooked, Bicellular glandular capitate type and Unicellular dolebrate type only.

Stachytarpheta indica is the only herbal taxa among the studied species of tribe verbenaeae. Structure and distribution of trichomes in this is quite interesting. Beside the general distribution of Unicellular papillose, Unicellular flagellate, Unicellular conical. Unicellular hooked, Bicellular cylidrical, Bicellular hooked, Uniseriate hooked & Unicellular glandular capitate types on the different parts, the presence of Bicellular glandular capitate type on the corolla as well as on stamens make it quite distinct from all studied taxa of the family.

Nyctanthes arbor-tristis, so far regarded as a member of Oleaceae has been transferred by H. K. Airy Shaw (in Kew Bull. 272, 1952); Maheshwari 1963 to the family Verbenaceae under a new sub family

Nyctanthoideae, Airy Shaw. Stant (in Kew Bull 273-276 : 1952), considers several morphological and anatomical features to differ from those in the Oleaceae but in favour of verbenaceous affinity. Hutchinson in 1948 : 1973 considered this genera in Verbenaceae. (Families of Flowering Plants, 487 : 1973). Trichomic complex recorded in this taxa does not reveal quite association with the trichomes observed in the other taxa of verbenaceae studied. In N. arborescens only 7 types of Unicellular and Uniseriate forms are recorded. Among these the distribution of Uniseriate torulose trichomes on the lower surface of leaves and total absence of Glandular forms from the taxa, provide it taxonomic identity.

Species of verbena i.e. V. bipinnatifida, V. bonariensis & V. officinalis are much different from each other so far as trichome complements are concerned. V. bipinnatifida and V. bonariensis resemble only in Unicellular glandular capitate type. The former species can be separated due to the presence of Unicellular papillose, Bicellular conical, Bicellular hooked, Uniseriate filiform, Uniseriate branched, Peltate & Uniseriate glandular

capitate types. The V. bonariensis & V. officinalis show greater affinities possessing Unicellular conical & Uniseriate non-glandular forms. Even then the presence of Unicellular glandular capitate & Bicellular glandular capitate in V. bonariensis and presence of Peltate type on both vegetative and floral parts with total absence of Glandular forms in taxa V. officinalis provide a taxonomic identification. Further V. bonariensis and V. bipinnatifida are similar in Unicellular papillose, Unicellular acerate, & Peltate trichomes, but the presence of Peltate hairs only on the floral parts, Uniseriate glandular capitate on both vegetative and floral parts in the taxa V. bipinnatifida make it stand quite apart from the remaining two species. Thus trichome complex among these three species of Verbena reveals that V. bonariensis & V. officinalis are more similar than V. bipinnatifida.

In the Durenta plumieri 9 type of trichomes viz.: Unicellular acuminate, Unicellular conical, Unicellular curved, Bicellular aseptate flagellate, Bicellular curved, Uniseriate falcate, Peltate,

Bicellular glandular capitate and Uniseriate glandular capitate type, are observed. Among these the distribution of Uniseriate glandular capitate type observed both on corolla & stamens, as well as restricted occurrence of Uniseriate falcate on various organs on this taxa, provide it a taxonomic significance to trichome structure. (Table IV & V).

Three species of callicarpa differ from each other so far as the trichome compliments are concerned. C. lanata & C. macrophylla have been found to be related to each other in having common Unicellular flagellate, stellate multiradiate, Unicellular glandular capitate, Uniseriate glandular capitate types and the absence of Bicellular and Uniseriate forms. The presence of Unicellular acerate, Dendroid, Stellate tri-radiate & Dendroid glandular capitate in the former species and Peltate forms in the latter provide taxonomic marker. C. lanata and C. tomentosa show similarity in having the Dendroid forms on both vegetative and floral organs. The taxa C. tomentosa stands apart from the remaining other two species of callicarpa on the basis of occurrence of Unicellular hooked, Bicellular filiform Bicellular hooked, Uniseriate hooked and Bicellular glandular capitate

forms. Whereas C. lanata is quite distinct bearing Stellate triradiate on gynoecium and Unicellular glandular capitate on corolla. Such type of distribution is not observed in the remaining two species of callicarpa studied. Thus a particular trichome with its identical distribution pattern shows its taxonomic value in the genus. Owing to the trichomic complex, Tectona grandis stands quite distinct from remaining studied species of this family. The distribution of Peltate, Dendroid and Dendroid glandular capitate trichomes are very interesting. Beside the other organs the presence of Dendroid and Bicellular glandular capitate forms on the gynoecium is of considerable taxonomic significance.

The taxa Premna latifolia & P. wightiana stand nearer, sharing Unicellular flagellate, Bicellular hooked, Uniseriate hooked, Unicellular glandular capitate & Bicellular glandular capitate types. But former species can be separated from latter by the presence of Unicellular papillose, Unicellular conical, Unicellular hooked, Unicellular torulose, Bicellular aseptate flagellate, Bicellular conical, Uniseriate filiform, Uniseriate conical, Uniseriate

furcate types. Whereas, latter species have Bicellular cylindrical, Bicellular curved, Bicellular belemnoid, Uniseriate septate flagellate, Uniseriate curved, Uniseriate acuminate forms. Moreover the presence of Unicellular flagellate on the gynoeceum of P. wightiana provides it a taxonomic distinction.

Species of Gmelina i.e. G. arborea. & G. philipensis show resemblance with each other in presence of Bicellular aseptate flagellate, Bicellular cylindrical, Uniseriate aseptate flagellate, Uniseriate hooked & Unicellular glandular capitate forms. The latter species can be separated by the presence of Unicellular curved, Unicellular dentate, Bicellular hooked, Peltate & Uniseriate glandular capitate types. Whereas, the presence of Bicellular conical, Unicellular glandular capitate & Bicellular glandular capitate on the stamen of former species, (Bicellular glandular capitate is present only on the stamen.) is a distinctive feature. In G. philipensis due to the presence of Unicellular dentate, Bicellular aseptate flagellate, Bicellular hooked types on corolla and only Uniseriate glandular capitate on the stamen make it stand quite apart from the other taxa.

All the four species of *Vitex* exhibit only Bicellular hooked as common trichome. Though in *V. negundo*, *V. agnus-castus* & *V. siamica*, Unicellular papillose, Bicellular conical and Uniseriate septate flagellate types are observed as common form of hairs. *V. negundo* can be separated from the others in having Bicellular curved, Uniseriate filiform, Uniseriate aseptate flagellate, Uniseriate cylindrical and Uniseriate furcate types on both vegetative and floral parts and Unicellular glandular capitate only on vegetative parts. *V. agnus-castus* distinct from the remaining considered taxa revealing frequent occurrence of Unicellular glandular capitate type on calyx only. The occurrence and distribution of trichome types in *V. siamica* is very interesting. In this taxa all the recorded 12 trichome types were distributed on the floral parts, (Table IV). The distribution on vegetative parts was very poor i.e. out of 12 recorded types of trichomes, only Bicellular filiform and Peltate type were observed on various vegetative organs. Further among the floral parts, an occurrence of Bicellular cylindrical Bicellular conical, Uniseriate conical & Bicellular

glandular capitate types on stamen and Peltate even on the gynoecium provide a taxonomic significance in identification of V. siamica. Besides the Bicellular hooked as the common type of trichome in the four species studied, V. coriacea bearing ten type of trichomes reveals more similarity to the V. siamica in having Bicellular filiform, Uniseriate hooked and Peltate types than with V. negundo, which has Uniseriate hooked & Uniseriate glandular Capitate as common trichomes and lastly with V. agnus-castus sharing Unicellular hooked types only. It has already been established that the particular trichome structure and their distribution provide a tool in solving the taxonomic problem. Thus V. coriacea appeared quite distinct from the rest considered species of Vitex having Uniseriate hooked, Uniseriate torulose, Unicellular glandular capitate hairs on corolla and Bicellular filiform & Bicellular belemnoid on stamen (Table IV). Similarly the presence of Uniseriate septate flagellate type both on corolla & stamen show trichomic identity in the taxa V. negundo.

Ten species of the genus Clerodendron showed 24 type of trichomes i.e. 21 Non glandular and 3

Glandular types. The perusal of tables IV & V reveals that some trichomes are common to most of the species, while others are either not so common or restricted in their distribution to one or two species. For example : Peltate, Unicellular glandular capitate, Uniseriate curved, Bicellular hooked, Bicellular conical, Uniseriate filiform, are common forms and observed in 8, 8, 7, 6, 5 & 5 species respectively. Each of the following trichomes i.e. Unicellular papillose, Unicellular conical, Bicellular aseptate flagellate, Uniseriate aseptate flagellate, Uniseriate septate flagellate, Uniseriate hooked and Bicellular glandular capitate is distributed in three species. Other forms restricted to two species are : Unicellular hooked in C. peniculatum & C. splendens and Uniseriate furcate in C. phlomidis & C. splendens. Remaining trichome types are of rare occurrence and help to distinguish some of the species of Clerodendron viz. : Unicellular curved on stem, petiole, leaf, calyx of C. inerme; Unicellular dentate on stem, petiole, leaf, calyx & corolla of C. peniculatum; Bicellular curved on stem, leaf, & bract of C. phlomidis; Bicellular filiform on petiole, leaf, infl. axis, bract & calyx

of C. multizuga are restricted to a particular species. Owing to the restricted distribution of these hairs they show taxonomic significance. C. fragrans & C. indicum which are found closer to each other sharing Unicellular glandular capitate form and the absence of Unicellular forms, they could easily be separated on the basis of other trichome complements. The former shows Bicellular conical, Uniseriate conical, Uniseriate curved types and lack Peltate type, whereas, the latter has Peltate type of hairs. Though Peltate hairs are also lacking in C. serratum, but it is quite distinct from C. fragrans possessing Uniseriate glandular capitate on the corolla, Uniseriate filiform & Unicellular papillose on both vegetative & floral parts.

Similarly Clerodendron infortunatum, C. multiflorum and C. splendens are found closer in Uniseriate filiform, Uniseriate curved and Peltate type of hairs. Distinction in between these three, can be made on the basis of Bicellular glandular capitate and Uniseriate glandular capitate hairs, which are found on the corolla & gynoecium of C. multiflorum and only on corolla along with

Unicellular and Bicellular forms in the C. splendens. The C. infortunatum gets separated having only Bicellular glandular capitate along with Unicellular, Bicellular and Uniseriate hairs.

The taxa Holmskioldia sanguinea & caryopteris wallichiana although have been found similar in having Unicellular papillose, Uniseriate septate flagellate, Uniseriate hooked, Uniseriate furcate, Peltate and Unicellular glandular capitate ones. Yet they show marked differences in other form of hairs. (Table IV & V). In H. sanguinea maximum variety of trichome types were recorded i.e. 14 types. Though some of the trichomes are common in other species. The distribution patterns particularly in floral parts gives a distinct taxonomic significance. Floral parts of H. sanguinea possess Unicellular conical, Unicellular curved, Bicellular conical, Uniseriate aseptate flagellate, Peltate and Uniseriate glandular capitate on corolla; Unicellular papillose, Uniseriate conical, Peltate & Unicellular glandular capitate on stamen and Peltate trichomes even on the gynoecium. Moreover Uniseriate acerate type is recorded in this taxa only. Similarly the distribution of Bicellular filiform & Bicellular

hooked hairs on vegetative and floral parts;
Bicellular glandular capitate on stem & bract and
Uniseriate branched hairs on calyx in Caryopteris
Wallichiana provide significant for differentiating
it from the H. sanguinea.

TABLE - III

**TOTAL TRICHOME TYPES OBSERVED IN THE FAMILY
VERBENACEAE**

S.NO.	TRICHOME TYPE	CODE
Non-glandular Type		
1	Unicellular papillose	A1
2	Unicellular flagellate	A2
3	Unicellular acerate	A3
4	Unicellular acuminate	A4
5	Unicellular conical	A5
6	Unicellular curved	A6
7	Unicellular hooked	A7
8	Unicellular dentate	A8
9	Unicellular torrulose	A9
10	Unicellular dolebrate	A11
11	Bicellular filiform	B1
12	Bicellular aseptate flagellate	B2
13	Bicellular cylindrical	B4
14	Bicellular conical	B5
15	Bicellular curved	B6
16	Bicellular hooked	B7
17	Bicellular belemnoid	B9
18	Uniseriate filiform	C
19	Uniseriate aseptate flagellate	D
20	Uniseriate septate flagellate	E
21	Uniseriate cylindrical	F
22	Uniseriate conical	G
23	Uniseriate curved	H
24	Uniseriate hooked	I
25	Uniseriate acerate	J
26	Uniseriate acuminate	K
27	Uniseriate furcate	L
28	Uniseriate branched	M
29	Uniseriate torrulose	N
30	Uniseriate falcate	O
31	Dendroid	P
32	Stellate triradiate	Q2
33	Stellate multiradiate	Q3
34	Peltate	R
Glandular Type		
35	Unicellular glandular capitate	S
36	Bicellular glandular capitate	T
37	Uniseriate glandular capitate	U
38	Dendroid glandular capitate	V

CHAPTER IV

STUDY OF TRICHOMES IN LAMIACEAE.

A. STRUCTURE OF TRICHOMES.

B. OBSERVATION & DISCUSSION.

CHAPTER IV

STUDY OF TRICHOMES IN LAMIACEAE

(A) STRUCTURE OF TRICHOMES

Fifty species belonging to twenty four genera of the Lamiaceae have been studied for their trichomes. Structural details of the trichomes and their distribution on various parts of the individual species are given below :-

OCIMUM BASILICUM

Species shows eight type of trichomes. (Plate 16, Fig. 1-8)

1. UNICELLULAR DENTATE HAIR

Foot: Simple. Body: Entire, dentate; tip pointed; base wide, walls thin, rugose; lumen wide; content translucent. Distrib.: Leaf margin, Bract & calyx. (Fig.1)

2. BICELLULAR CONICAL HAIR.

Foot: Compound. Body: 2 - celled, entire, long,

conical, tapering; tip pointed; lateral & cross wall thin, rugose; lumen wide; content translucent. Distrib.: Stem, petiole, leaf, bract & calyx. (fig.2).

3. BICELLULAR CURVED HAIR.

Foot: Simple. Body: 2-celled, entire, curved; gradually tapering to a pointed tip; lateral and cross walls thin, rugose; lumen wide; content translucent. Distrib. : Stem, petiole, leaf-lower surface & margin, bract and calyx. (fig.3)

4. BICELLULAR BELEMNOID HAIR.

Foot: Compound. Body: 2-celled, erect, belemnoid; lower cell broad and long, upper cell narrow and acuminate; tip pointed; lateral wall thick, rugose; cross wall thin; lumen wide; content translucent. Distrib. : Leaf-margin, bract and calyx (Fig.4)

5. UNISERiate CONICAL HAIR

Foot: Simple. Body: 3-8 celled, entire, elongated, conical; cells of varied length, upper cell elongated and tapering, lower cell broad; tip pointed; lateral walls thin, rugose, convex, constricted at joints; lumen wide; content translucent. Distrib. : Stem, petiole, leaf & Infl. axis, bract, calyx and corolla. (Fig.5)

6. UNISERiate HOOKED HAIR.

Foot: Simple. Body: 3-6 celled, entire, hooked; cells of varied length, uppermost cell elongated, rest broader; tip pointed; lateral walls thick, rugose, swollen at joints; cross walls thick; lumen wide; content translucent. Distrib. : Stem, petiole, leaf lower surface & margin, Infl. axis & bract. (Fig.6)

7. UNISERiate ACERATE HAIR.

Foot: Compound. Body : 4-8 celled, entire, very long, acerate; cells narrowly elongated; tip sharply pointed; lateral walls thin, rugose, straight; cross wall thin; lumen narrow; content opaque; Distrib.: Petiole and leaf-lower surface. (Fig.7)

8. UNICELLULAR GLANDULAR CAPITATE HAIR

Foot: Simple. Body: Differentiated; stalk 1-celled, short, rectangular, walls thin & smooth, content translucent; head 1-celled, large, globose, wall thin; content dense. Distrib.: Stem, petiole, leaf-surface, Infl. axis, bract, calyx & corolla. (Fig.8)

OCIMUM CANUM

This species shows six type of trichomes. (Plate 16, Fig. 9-14)

1. UNICELLULAR PAPILLOSE HAIR

Foot: Simple. Body: 1-celled, entire, papillose; cell longer than breadth; tip rounded; walls thin, rugose, straight; lumen wide; content translucent. Distrib. : Calyx. (Fig.9)

2. UNICELLULAR DENTATE HAIR.

Foot: Simple. Body: 1-celled, entire, dentate; cell tapering and longer than breadth; tip pointed; walls thin, rugose, straight; lumen wide; content translucent. Distrib. : Leaf upper surface & calyx. (fig.10).

3. BICELLULAR HOOKED HAIR.

Foot: Simple. Body: Entire, elongated, hooked; cells longer than breadth, lower cell smaller than upper; upper cell tapering to a pointed tip; walls thick, rugose; lumen wide; content translucent. Distrib. : Petiole, leaf, calyx. (fig.11)

4. UNISERiate CONICAL HAIR.

Foot: Simple. Body: 3-8 celled, entire, conical; cells longer than breadth, lower cell wide, upper cell narrow, tapering to a pointed apex; lateral & cross walls thin, rugose, straight; lumen narrow;

Explanation of the figures of Plate 16.

Trichomes from Various Plant parts.

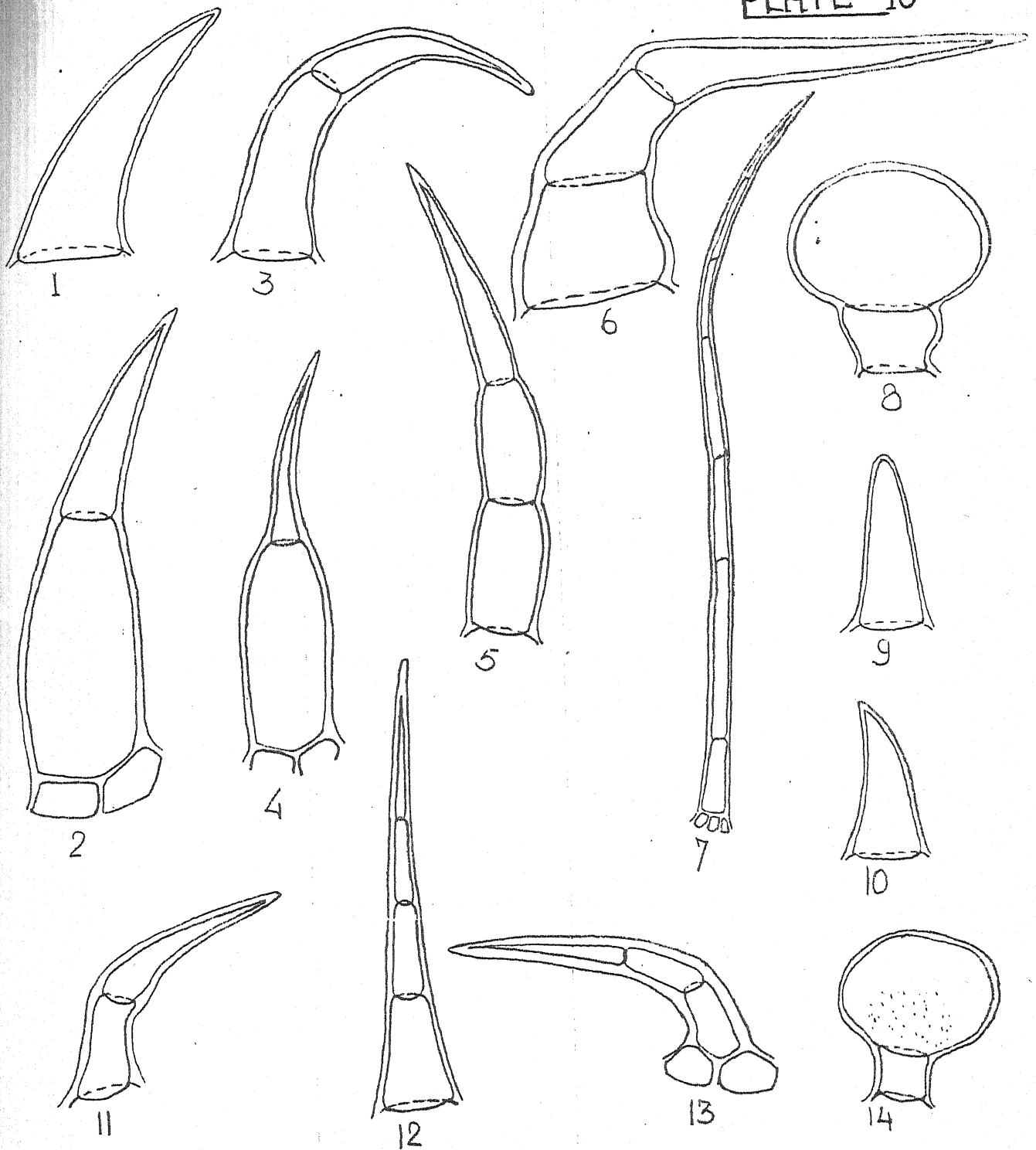
Figs. 1-8 : Ocimum basilicum.

Figs. 1, 4	:	Leaf margin.
Fig. 2	:	Calyx.
Fig. 3	:	Leaf upper.
Figs. 5, 7	:	Petiole.
Figs. 6, 8	:	Stem.

Figs. 9 - 14 : Ocimum canum.

Figs. 9, 10, 12.	:	Calyx.
Fig. 11	:	Petiole.
Figs. 13, 14.	:	Stem.

PLATE-16



$\frac{100 \mu}{7}$

$\frac{100 \mu}{11-14}$

$\frac{50 \mu}{5,6}$

$\frac{25 \mu}{1-4, 9-10}$

content translucent. Distrib. : Leaf-upper surface & calyx (Fig.12)

5. UNISERIATE HOOKED HAIR

Foot: Compound. Body: 3-6 celled, entire, hooked; cells of varied length and longer than breadth; tip pointed; lateral walls thick, rugose; cross walls thin; lumen wide; content opaque. Distrib. : Stem, petiole, leaf, calyx. (Fig.13)

6. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: differentiated; stalk 1-celled, shorter than head, rectangular, walls thin, content translucent; head 1-celled, large, capitate, globose, wall thin, content dense granulated. Distrib. : Stem, petiole, leaf-surface & calyx. (Fig.14)

OCIMUM GRATISSIMUM

The plant shows seven types of trichomes. (Plate 17, Fig. 15-21)

1. UNICELLULAR PAPILLOSE HAIR

Foot: Simple. Body: 1-celled, entire, papillose, cell longer than breadth, tapering to a rounded tip; walls

thin, smooth, lumen wide; content translucent.
 Distrib.: Leaf-upper surface, Infl. axis & calyx.
 (Fig.15)

2. UNICELLULAR HOOKED HAIR.

Foot: Simple. Body: Entire, hooked; cell turn aside
 & longer than breadth; tapering to a pointed tip;
 walls thick, smooth; lumen wide; content translucent.
 Distrib. Leaf-margin & bract. (fig.16).

3. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: 2-celled, entire, elongated,
 conical; cells longer than breadth; tip obtuse;
 lateral walls thin, rugose, straight, cross walls
 thin; lumen wide; content translucent. Distrib. :
 Leaf-upper surface, Infl. axis, bract, calyx and
 corolla. (fig.17)

4. BICELLULAR HOOKED HAIR.

Foot: Simple. Body: 2-celled, entire, hooked; cells
 of equal size and longer than breadth; tip pointed;
 lateral & cross wall thin; rugose, constricted at
 joint; lumen wide; content translucent. Distrib. :
 Petiole, Leaf-upper surface & margin, Infl. axis,
 bract and calyx (Fig.18)

5. UNISERiate CONICAL HAIR

Foot: Simple. Body: 3-8 celled, entire, conical; cells of varied length, middle cells longer than breadth, upper cell narrowly elongated, basal cell wide and broader than length; tip pointed; lateral walls thick or thin, rugose, convex; cross wall thin; lumen wide; content translucent. Distrib. : Leaf upper surface, Infl. axis, bract, calyx and corolla. (Fig.19)

6. UNISERiate HOOKED HAIR.

Foot: Simple. Body: 3-5 celled, entire, hooked; cells longer than breadth, tapering to a pointed apex; lateral & cross walls thick, rugose, swollen at joints; lumen wide; content opaque. Distrib. : Petiole, Leaf-upper surface, Infl. axis, bract & calyx. (Fig.20)

7. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Body: differentiated; stalk 1-celled, shorter than head and wider than length, walls thin, content translucent; head 1-celled, very large, capitate, globose, wall thin, content dense granulated. Distrib. : Stem, petiole, leaf surface, Infl. axis, bract & calyx. (Fig.21)

OCIMUM SANCTUM

The plant shows eight types of trichomes. (Plate 17, Fig. 22-29)

1. UNICELLULAR PAPILLOSE HAIR

Foot: Simple. Body: 1-celled, entire, papillose, cell longer than breadth; tip rounded; walls thin, rugose, convex; lumen wide; content translucent. Distrib.: Petiole, Leaf-upper surface, & calyx. (Fig.22)

2. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: Entire, conical; cells wide & longer than breadth; lower cell small & wider, upper cell tapering to a obtuse tip; lateral & cross walls thick, rugose, swollen at joints; lumen wide; content translucent. Distrib. Petiole, Leaf, calyx. (fig.23).

3. UNISERiate SEPTATE FLAGELLATE HAIR.

Foot: Compound. Body: 3-14 celled, very long, flagellate; cells of varied length, lower most cell wider and rectangular, other cell narrowly flexuous; tip pointed; lateral & cross walls thin, rugose, wavy; lumen narrow; content opaque. Distrib. : Stem, petiole, leaf and calyx. (fig.24)

Explanation of the figures of Plate 17.

Trichomes from Various Plant parts.

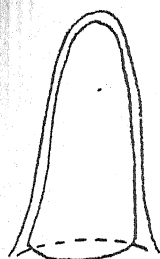
Figs. 15 - 21 : Ocimum gratissimum.

Figs. 15, 17	:	L. lower surface.
Fig. 16	:	L. margin.
Fig. 18	:	Petiole.
Figs. 19, 20	:	Infl. axis.
Fig. 21	:	Stem.

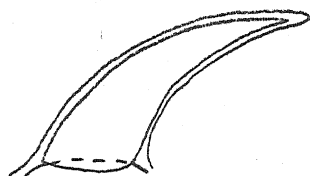
Figs. 22 -29 : Ocimum sanctum.

Figs. 22, 23	:	Petiole.
Figs. 24, 25, 27, 28	:	Stem.
Fig. 26	:	Petiole.
Fig. 29	:	Corolla.

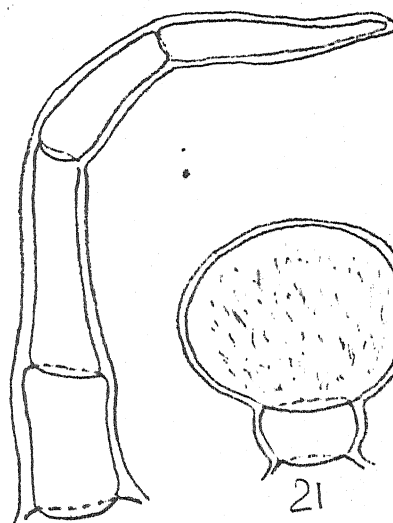
PLATE-17



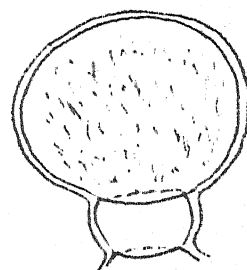
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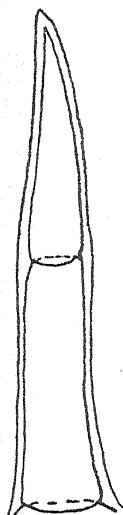
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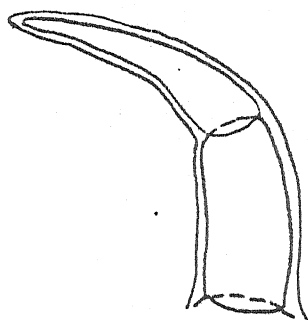
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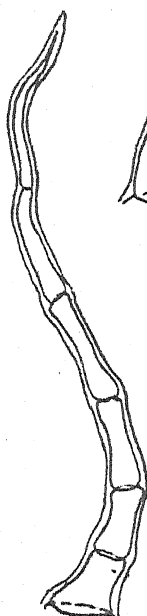
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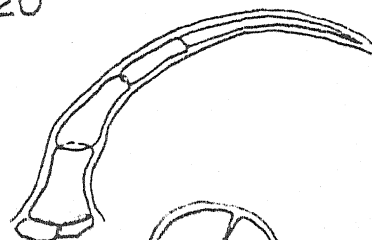
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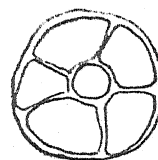
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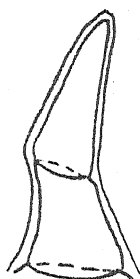
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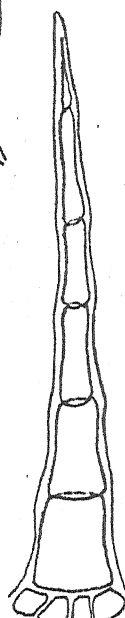


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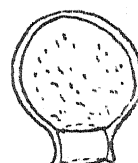


23

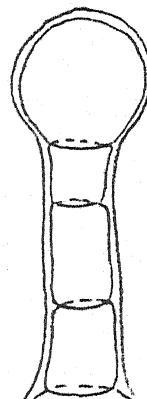
24



25



28



29

100 μ
19, 24, 25.

100 μ
20, 26, 27.

50 μ
22, 23

50 μ .
15-18, 21, 28, 29

4. UNISERiate CONICAL HAIR.

Foot: Compound. Body: 5-14 celled, elongated, conical; cells of varied length and longer than breadth; tip pointed; lateral & cross walls thin; rugose, swollen at joints; lumen wide; content translucent. Distrib. : Stem, petiole, Leaf-surface, calyx & corolla. (Fig.25)

5. UNISERiate HOOKED HAIR

Foot: Compound. Body: 3-8 celled, entire, hooked; cells of varied length, terminal cells narrowly curved, lowermost cell wide, median cells narrow and longer than breadth; tip sharply pointed; lateral walls thick, rugose, cross wall thin; lumen narrow; content translucent. Distrib. : Stem, petiole, leaf and calyx. (Fig.26)

6. PELTATE HAIR.

Foot: Not visible. Body: Shield-like, circular, 1-cell thick, 5-8 cell in diameter; cells rectangular, radiating from center, center hollow, outer and lateral walls thin, prominent; lumen wide; content opaque. Distrib. : Stem, petiole, leaf surface, calyx and corolla. (Fig.27)

7. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, short, rectangular, thin walled, content translucent; head 1-celled, large, capitate, globose, wall thin; content dense granulated. Distrib. : Stem, petiole, leaf, calyx and stamen. (Fig.28)

8. UNISERIATE GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 3-4 celled, cells of varied length, cells longer than breadth except upper cell, wall thin & smooth, content translucent; head 1-celled, capitate, globose, wall thin, content light yellow granulated. Distrib. : Corolla and stamen. (Fig.29)

OCIMUM KILIMANDS CHARICUM

This species shows thirteen types of trichomes.
(Plate 18, Fig. 30-42)

1. UNICELLULAR PAPILLOSE HAIR

Foot: Simple. Body: Entire, elongated, papillose, tip rounded; walls thin and smooth; lumen wide; content pale yellow. Distrib.: Leaf-margin and corolla.
(Fig.30)

2. UNICELLULAR CONICAL HAIR.

Foot: Simple. Body: Entire, conical; cells longer than breadth, base wide; obtuse tip; walls thin, smooth & straight; lumen wide; content translucent. Distrib. calyx. (fig.31).

3. UNICELLULAR DENTATE HAIR.

Foot: Simple. Body: 1-celled, elongated, dentate. base wide; tapering to pointed apex, walls thick, smooth, straight; lumen wide; content translucent. Distrib. : calyx. (fig.32)

4. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: Entire, conical; cells longer than breadth; upper cell more elongated than lower & tapering into pointed apex; lateral walls thick; smooth & straight; cross wall thin; lumen wide; content translucent. Distrib. : Leaf-surface, calyx. (Fig.33)

5. BICELLULAR HOOKED HAIR

Foot: Simple. Body: 2-celled, elongated, hooked; cells of equal size; upper cells narrower into a pointed apex; lateral and cross walls thin, smooth and turn aside; lumen wide; content translucent. Distrib. : Leaf and calyx. (Fig.34)

6. UNISERiate FILIFORM HAIR.

Foot: Compound. Body: 3-10 celled, entire, uniseriate, filiform, cells much longer than breadth; tip pointed; lateral & cross walls thin, smooth, straight, swollen at joints; lumen wide; content translucent; Distrib. : Leaf, calyx and Corolla. (Fig.35)

7. UNISERiate SEPTATE FLAGELLATE HAIR.

Foot: Compound. Body: 3-12 celled, entire, septate, flagellate, cells narrow, elongated; tip pointed; lateral and cross walls thin, smooth and flexuous; lumen varied; content translucent. Distrib. : Corolla. (Fig.36)

8. UNISERiate CONICAL HAIR.

Foot: Compound. Body: 3-8 celled, entire, erect, conical; cells elongated and equal in length; tip pointed; lateral walls thick, smooth, swollen at joints; cross walls thin; lumen wide; content translucent. Distrib. : Leaf-surface & calyx. (Fig.37)

9. UNISERiate CURVED HAIR.

Foot: Compound. Body: 3-10 celled, uniseriate,

curved, cells equal in length; tip pointed; lateral & cross walls thin, smooth, turn aside; lumen wide; content translucent. Distrib. : Leaf & calyx. (Fig.38)

10. UNISERIATE HOOKED HAIR

Foot: Compound. Body: 3-10 celled, entire, hooked, cells turn aside in the form of hook, cells equal in length, cells tapering in pointed apex; lateral & cross walls thick, smooth, lumen wide; content translucent. Distrib. : Leaf and calyx. (Fig.39)

11. PELTATE HAIR.

Foot: Not visible. Body: Multicellular, shield like, entire, circular in shape, 1-celled thick, 6-8 cell in diameter; cells radiating from center; outer and lateral walls thin, smooth, content dark brown (opaque) Distrib. : leaf-surface, calyx and corolla. (Fig.40)

12. UNICELLULAR GLANDULAR CAPITATE HAIR

Foot: Simple. Body: 2-celled, differentiated; stalk 1-celled, short, cell wider than length; walls thin & smooth; content translucent; head 1-celled, large, capitate, wall thin, smooth; content light pale yellow. Distrib.: leaf & calyx. (Fig.41)

13. BICELLULAR GLANDULAR CAPITATE HAIR

Foot: Simple. Body: Differentiated; stalk 2-celled, upper cell short, collared, lower cell prominent, longer than breadth, lateral wall thick and smooth, content translucent; head 1-celled, capitate, large, globose, wall thin and smooth; content granular. Distrib.: calyx. (Fig.42)

ORTHOSIPHON PALLIDUS

It shows seven types of trichomes. (Plate 18 & 19, Fig. 44-49)

1. UNICELLULAR PAPILLOSE HAIR

Foot: Simple. Body: Variously papillose, cell much elongated than breadth; tip rounded; walls thin, smooth and convex; lumen wide; content light yellow. Distrib.: Stem, calyx, corolla. (Fig.43)

2. UNICELLULAR HOOKED HAIR.

Foot: Simple. Body: Entire, hooked, cell elongated than breadth; tip pointed; walls thick, smooth, turn aside; lumen wide; content translucent. Distrib. Leaf. (fig.44).

Explanation of the figures of Plate 18.

Trichomes from Various Plant parts.

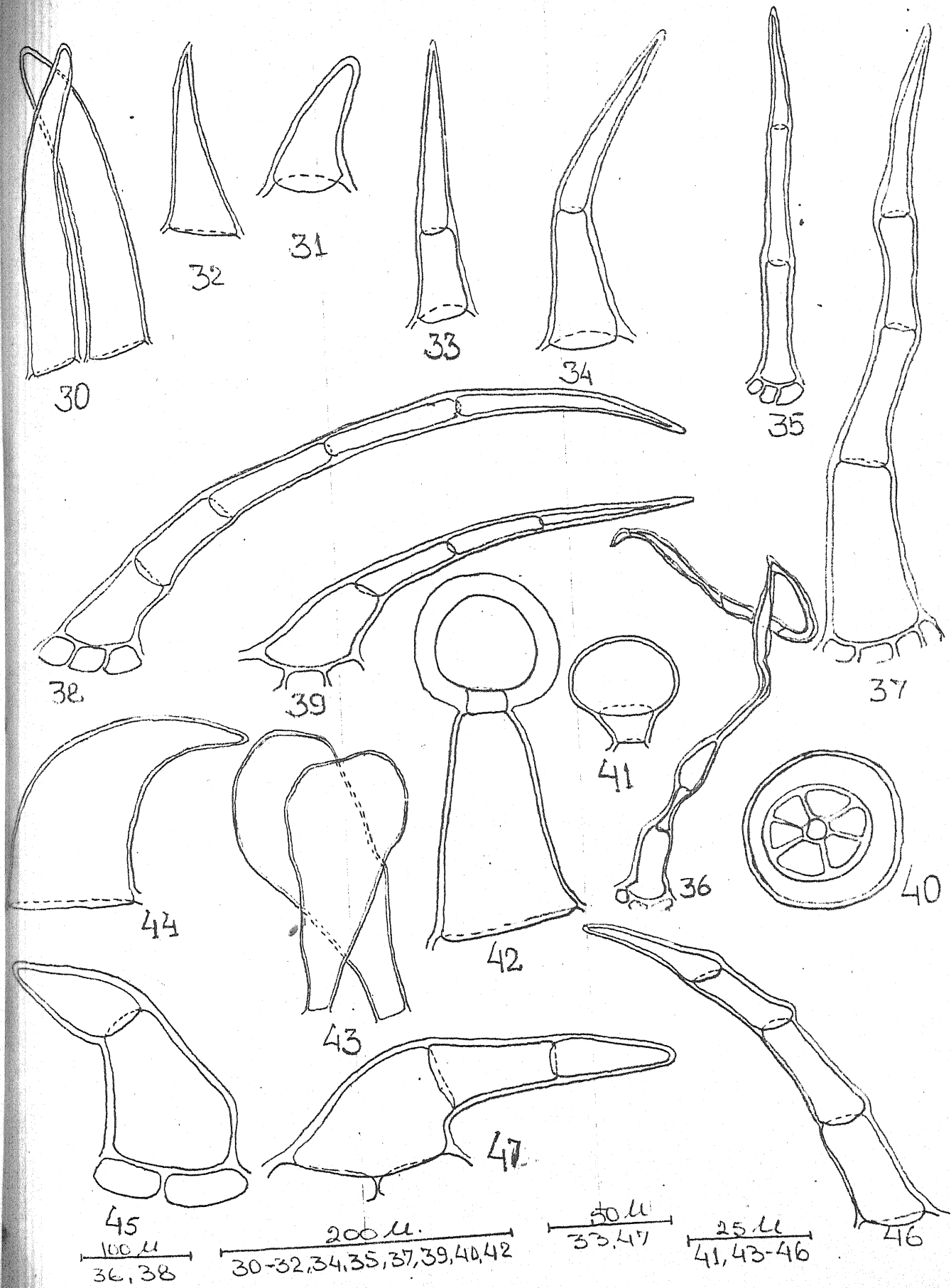
Figs. 30 - 42 : Ocimum kilimandscharicum.

Figs. 30, 36	:	Corolla.
Figs. 31, 32, 42	:	Calyx.
Figs. 33, 34, 35, 37, 38, 39 40, 41	:	Leaf upper.

Figs. 43 - 49 : Orthosiphon pallidus.

Fig. 43	:	Corolla.
Fig. 44	:	L. upper.
Figs. 45, 47	:	Stem.
Fig. 46	:	Petiole.

PLATE-18



3. BICELLULAR HOOKED HAIR.

Foot: Compound. Body: 2-celled, entire, elongated, hooked, lower cell longer and wider than upper; tip pointed; lateral walls thick, smooth; cross wall thin; lumen wide; content translucent. Distrib. : Stem, petiole, leaf-surface, Infl. axis, calyx, corolla and ovary wall. (fig.45)

4. UNISERiate FILIFORM HAIR.

Foot: Simple. Body: 3-12 celled, entire, long, filiform, cells narrower towards the tip; tip pointed, cells of equal size; lateral walls thin; smooth & swollen at joints; cross wall thin; lumen wide; content translucent. Distrib. : Stem, petiole, leaf-surface, calyx, corolla and ovary walls. (Fig.46)

5. UNISERiate HOOKED HAIR

Foot: Compound. Body: 3-4 celled, hooked, cells elongated than breadth and of equal sizes; tip obtuse; lateral walls thick, smooth; cross walls thin; lumen wide; content translucent. Distrib. : Stem, petiole and calyx. (Fig.47)

6. UNISERIATE CONICAL HAIR.

Foot: Compound. Body: 3-4 celled, elongated, entire, conical, basal cell bulbous; tip pointed; lateral & cross wall thick, rugose and swollen at joints; lumen wide; content translucent; Distrib. : Infl. axis. (Fig.48)

7. UNICELLULAR GLANDULAR CAPITATE HAIR

Foot: Simple. Body: Differentiated; stalk 1 celled, rectangular, shorter than head, walls thin, smooth, content translucent; head large, capitate glandular cells 2, arrange lengthwise, wall thin, content dense. Distrib.: Stem, petiole, leaf-surface, Infl. axis, calyx, corolla and ovary walls (Fig.49)

ORTHOSIPHON RUBICUNDUS

Species shows nine type of trichomes. (Plate 19, Fig. 50-58)

1. UNICELLULAR DENTATE HAIR.

Foot: Simple. Body: Entire, dentate, base wide; cells tapering to a pointed apex; walls thin, rugose and slightly turn aside; lumen wide; content granulated. Distrib. : Stem, leaf & calyx. (fig.50)

2. BICELLULAR CYLINDRICAL HAIR.

Foot: Simple. Body: 2-celled, entire, cylindrical, elongated, cells much longer than breadth; tip obtuse; lateral & cross walls thin, & smooth; lumen wide; content translucent. Distrib. : Corolla. (Fig.51)

3. BICELLULAR CONICAL HAIR.

Foot: Compound. Body: Entire, conical, cells longer than breadth; tip pointed; lateral walls thick and rugose; cross wall thin; lumen wide; content light yellow. Distrib. : Leaf upper surface and margin, calyx. (Fig.52)

4. BICELLULAR HOOKED HAIR

Foot: Compound. Body: 2 celled, hooked, differentiated, upper cell acuminate, basal cell arrect and much wider than length; tip pointed, lateral walls thick, rugose, straight; cross walls thin; lumen wide and narrow; content yellowish. Distrib. : Leaf margin and calyx. (Fig.53)

5. UNISERiate CONICAL HAIR.

Foot: Simple. Body: 3-5 celled, entire, conical; cells of equal size; tip pointed; lateral wall thick,

rugose, straight; cross walls thin; lumen wide; content light yellow. Distrib. : leaf-surface & calyx. (Fig.54)

6. UNISERiate CURVED HAIR.

Foot: Compound. Body: 3-4 celled, entire, curved, cells longer than breadth and of equal size; tip pointed; walls thin and rugose; lumen wide; content light yellow; Distrib. : Corolla. (Fig.55)

7. UNISERiate HOOKED HAIR

Foot: Compound. Body: 3-5 celled, hooked, cells wider than length, terminal cell conical; tip pointed; lateral walls thick, rugose, convex, cross walls thin; lumen wide; content opaque. Distrib. : Leaf upper surface and margin, calyx. (Fig.56)

8. PELTATE HAIR.

Foot: Not visible. Body: shield like, circular in shape, parallel to the epidermis, 1 celled in thickness, 8-10 cell in diameter; cells radiating from center, hollow center; outer walls thin, smooth, lateral walls thin, prominent; content granulated dark yellowish. Distrib. : Stem, leaf-surface, calyx and corolla. (Fig.57)

9. BICELLULAR GLANDULAR CAPITATE HAIR

Foot: Simple. Body: Differentiated; stalk 2 celled, basal cell much elongated than upper rectangular cell, lateral & cross walls thin, rugose, content translucent; head 1-celled, oval, wall thin, lumen constricted, content granulated yellowish. Distrib.: calyx. (Fig.58)

PLECTRANTHUS COETSA

This species shows five type of trichomes. (Plate 19, Fig. 59-63)

1. UNICELLULAR PAPILLOSE HAIR

Foot: Simple. Body: Entire, elongated, papillose, cell longer than width; tip obtuse; walls thin, smooth and straight; lumen wide; content translucent. Distrib.: Leaf & corolla. (Fig.59)

2. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: Entire, long, conical, cell longer than breadth and of equal size; tip pointed; lateral & cross walls thin, smooth, straight; lumen wide; content translucent. Distrib. leaf & calyx. (fig.60).

Explanation of the figures of Plate 19.
Trichomes from Various Plant parts.

Figs. 48 - 49 : Orthosiphon pallidus.

Fig. 48	:	Infl. axis.
Fig. 49	:	Stem.

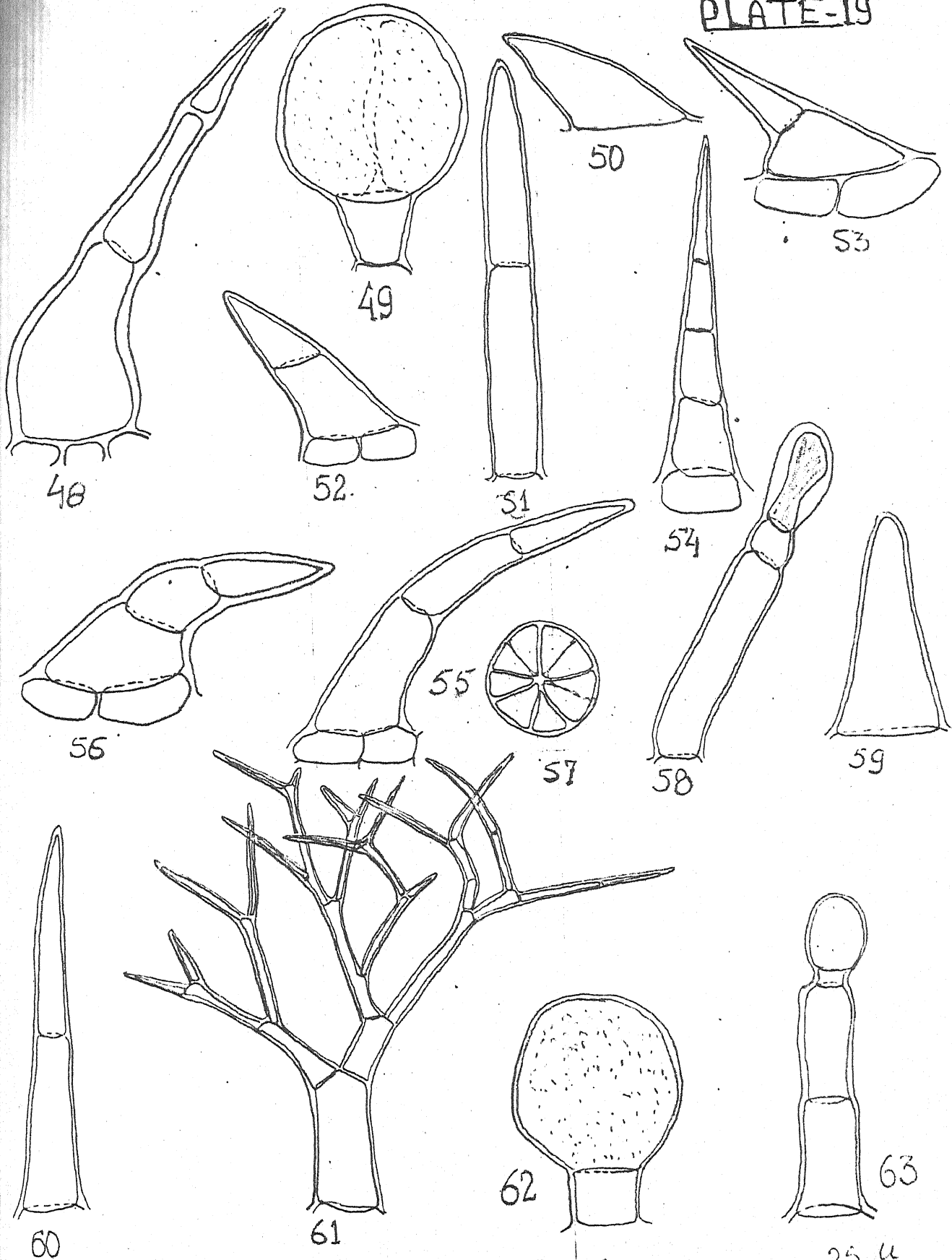
Figs. 50 - 58 : Orthosiphon rubicundus.

Figs. 50, 53	:	L. margin.
Figs. 51, 55	:	Corolla.
Figs. 52, 54, 56	:	L. upper.
Fig. 57	:	Stem.
Fig. 58	:	Calyx.

Figs. 59 - 63 : Plectranthus coetsa.

Fig. 59	:	L. margin.
Fig. 60	:	L. lower.
Figs. 61, 62, 63	:	Stem.

PLATE-19



400 μ
48, 49

100 μ
51, 54, 55, 61

50 μ
50, 52, 53, 56, 59, 60, 63

25 μ
57, 58, 62

3. UNISERiate BRANCHED HAIR.

Foot: Simple. Body: Multicellular, uniseriate, dichotomously branched, cells narrowly elongated; tip pointed; lateral & cross wall thick, smooth & straight; lumen narrow; content opaque; Distrib. : Stem, petiole, leaf and calyx. (Fig.61)

4. UNICELLULAR GLANDULAR CAPITATE HAIR

Foot: Simple. Body: Differentiated; stalk 1 celled, short, rectangular, walls thin & smooth, lumen wide and content translucent; head 1-celled, oval large, capitate, wall thick, content light yellow, granular. Distrib.: Stem, petiole, leaf, calyx. (Fig.62)

5. UNISERiate GLANDULAR CAPITATE HAIR

Foot: Simple. Body: Differentiated; stalk 3-4 celled, cells elongated and of equal size except the upper collar cell, walls thin; head 1-celled, large, capitate, oval, wall thin, content dense. Distrib.: Stem, petiole and corolla. (Fig.63)

PLECTRANTHUS MOLLIS

This species shows seven type of trichomes. (Plate 20, Fig. 64-72)

1. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: 2-celled, entire, conical, cells longer than width, upper cell cony; tip pointed, lateral walls thin, smooth and straight; cross wall thick; lumen wide; content opaque. Distrib. : Stem, leaf-surface, Infl. axis & calyx. (fig.64)

2. BICELLULAR BELEMNOID HAIR.

Foot: Simple. Body: 2-celled, elongated, belemnoid, cells elongated width, upper cells belemnoid, basal cell rectangular; tip pointed, lateral & cross walls thin, smooth and straight; lumen wide; content translucent. Distrib. : Leaf upper surface, Infl. axis and calyx. (Fig.65)

3. UNISERIATE CONICAL HAIR.

Foot: Compound. Body: 3-6 celled, entire, elongated or stout, conical, cells longer than width; tip obtuse; lateral & cross walls thick, smooth, swollen (Fig.66) or straight (Fig.67) or constricted (fig. 68) at joints; lumen narrow or shrinked or wide; content opaque. Distrib. : (Fig.66) Infl. axis, calyx; (Fig.67) stem, leaf; Infl. axis, calyx and corolla; (Fig.68) calyx.

4. UNISERiate CURVED HAIR.

Foot: Compound. Body: 3-8 celled, entire, long, curved, cells elongated than width, basal cell longest; tip pointed; lateral and cross walls thick, rugose, constricted at joints; lumen wide; content opaque; Distrib. : Stem, leaf, Infl. axis, calyx. (Fig.69)

5. UNISERiate HOOKED HAIR

Foot: Compound. Body: 3-6 celled, elongated, hooked, terminal cell abruptly bend to form hook; tip pointed, lateral & cross walls thick, rugose, constricted at joints; lumen wide; content opaque. Distrib. : Stem, leaf margin, and Infl. axis. (Fig.70)

6. PELTATE HAIR.

Foot: Not visible. Body: circular, parallel to the epidermis, 1 celled in thickness, 4-6 cell in diameter, cells radiating from center; outer walls thin, entire, cutinised; lateral walls thin, prominent; content opaque. Distrib. : Stem, leaf-surface, Infl. axis, calyx and corolla.

7. UNICELLULAR GLANDULAR CAPITATE HAIR

Foot: Simple. Body: Differentiated; stalk 1 celled,

short, rectangular, walls thin and smooth, lumen wide, content translucent; head 1-celled, very large, globose, wall thin, content dense. Distrib.: Stem, leaf-lower surface, Infl. axis, calyx. (Fig.72)

ANISOCHILUS CARNOSUS

Species shows five type of trichomes. (Plate 20, Fig. 73-77)

1. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: 2-celled, entire, conical, basal cell short, rectangular, upper cell elongated; tip pointed, lateral & cross walls thin, rugose, & straight; lumen wide; content opaque. Distrib. : Stem, petiole, leaf, Infl. axis & calyx. (fig.73)

2. UNISERIATE CONICAL HAIR.

Foot: Simple. Body: 3-6 celled, elongated, erect, conical, cells longer than width; tip pointed; lateral & cross walls thin, rugose and slightly constricted at joints, lumen wide; content opaque. Distrib. : Infl. axis, & calyx; (Fig.74)

Explanation of the figures of Plate 20.

Trichomes from Various Plant parts.

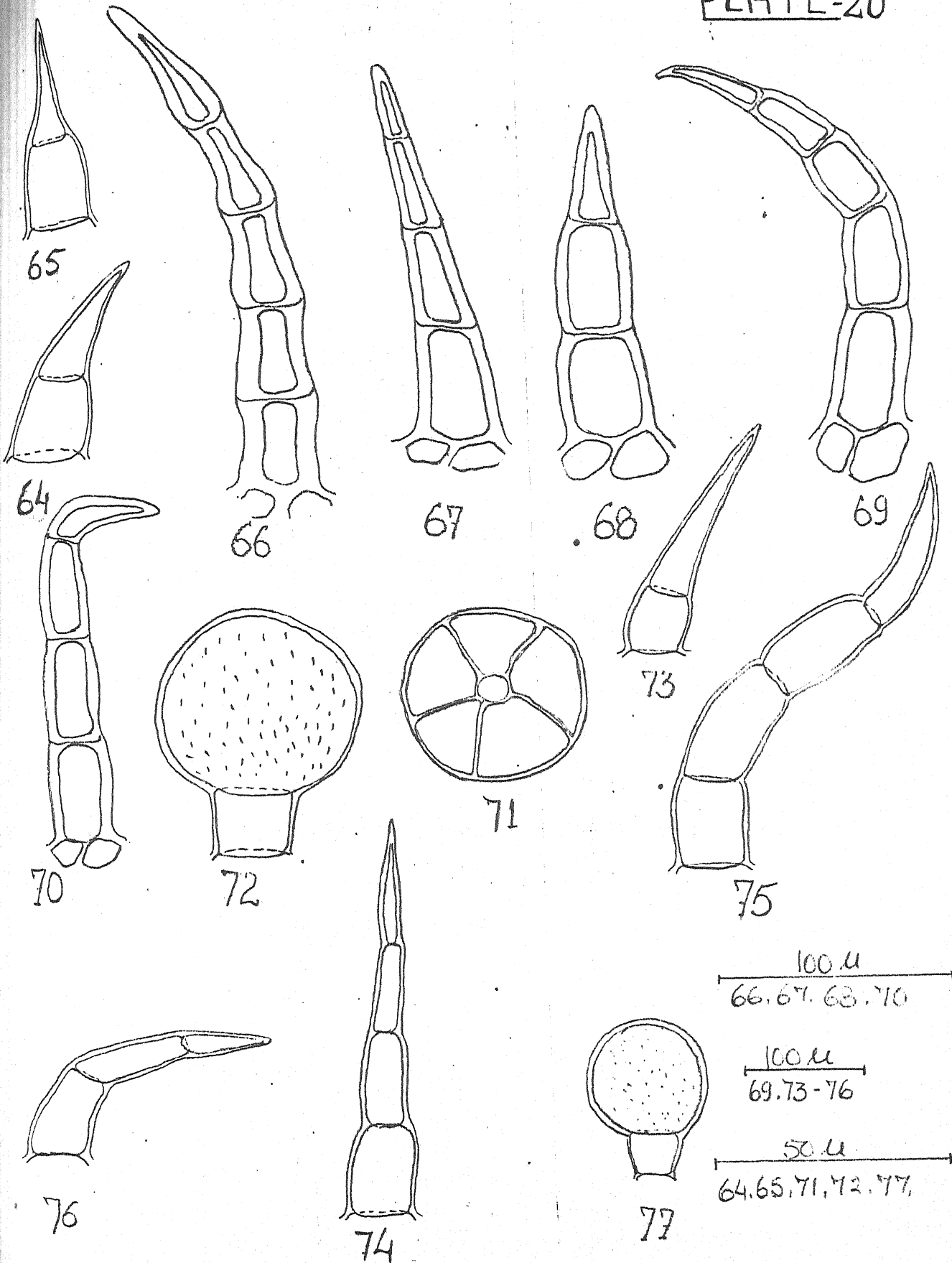
Figs. 64-72 : Plectranthus mollis.

Fig. 64	:	Leaf lower.
Fig. 65	:	Leaf upper.
Fig. 66	:	Infl. axis.
Figs. 67, 69, 70, 71, 72	:	Stem.
Fig. 68	:	Calyx.

Figs. 73 - 77 : Anisochilus carnosus.

Fig. 73	:	Stem.
Fig. 74	:	Infl. axis.
Fig. 75	:	Petiole.
Fig. 76	:	Leaf margin.
Fig. 77	:	Leaf upper.

PLATE-20



3. UNISERiate CURVED HAIR.

Foot: Simple. Body: 3-5 celled, entire, elongated, curved, cells longer than breadth and of equal size; tip pointed; lateral walls convex, thin, rugose, constricted at joints; cross wall thin; lumen wide; content opaque; Distrib. : Stem, petiole, leaf-surface, Infl. axis, calyx. (Fig.75)

4. UNISERiate HOOKED HAIR

Foot: Simple. Body: 3-4 celled, entire, hooked, cells of equal size and longer than width; tip pointed; lateral & cross walls thin, rugose, lumen wide; content opaque. Distrib. : leaf-margin and Infl. axis. (Fig.76)

5. UNICELLULAR GLANDULAR CAPITATE HAIR

Foot: Simple. Body: Differentiated; stalk 1 celled, short, rectangular, walls thin and smooth, lumen wide, content translucent; head 1-celled, large, capitate, rounded, wall thin, content dense. Distrib.: Stem, petiole, leaf-surface, Infl. axis & calyx. (Fig.77)

HYPTIS SUAVEOLENS

It shows eight type of trichomes. (Plate 21. Fig. 78-85)

1. UNICELLULAR CONICAL HAIR.

Foot: Simple. Body: Entire, conical; cells longer than breadth; obtuse tip; walls thick, smooth & straight; lumen wide; content translucent. Distrib. calyx. (fig.78).

2. BICELLULAR CONICAL HAIR.

Foot: Compound. Body: Entire, much elongated, conical, cells longer than width; tip pointed; lateral & cross walls thick; lumen wide; content translucent. Distrib. : Leaf, bract & calyx. (Fig.79)

3. UNISERIATE FILIFORM HAIR.

Foot: Compound. Body: 4-7 celled, entire, elongated, filiform, cells of equal size, cells longer than breadth; tip pointed; lateral & cross wall thick, smooth, straight, swollen at joints; lumen narrow; content opaque; Distrib. : calyx. (Fig.80)

4. UNISERIATE SEPTATE FLAGELLATE HAIR.

Foot: Compound. Body: 3-8 celled, long, septate, flagellate, cells narrowly elongated; tip pointed; lateral and cross walls thin, smooth, wavy; lumen narrow; content opaque. Distrib. : Corolla. (Fig.81)

5. UNISERIATE CONICAL HAIR.

Foot: Compound. Body: 3-6 celled, entire, conical; cells of equal size except the upper longest cell, lower 2-3 cells rectangular; tip pointed or obtuse; lateral & cross walls thick, smooth & constricted at joints; lumen wide; content light yellow. Distrib. : calyx. (Fig.82)

6. UNISERIATE CURVED HAIR.

Foot: Compound. Body: 3-4 celled, elongated, curved, cells more longer than width; terminal cell much elongated; tip pointed; lateral walls thick, smooth, swollen at joints; cross walls thick; lumen wide and narrow; content light yellow. Distrib. : Stem, petiole, Leaf-surface, bract. (Fig.83)

7. UNICELLULAR GLANDULAR CAPITATE HAIR

Foot: Simple. Body: Differentiated; stalk 1 celled, short, rectangular, broader than length, walls thin, lumen wide, content translucent; head 1-celled, large, globose, wall thick, content dark yellow. Distrib.: Bract, calyx & corolla. (Fig.84)

8. UNISERIATE GLANDULAR CAPITATE HAIR

Foot: Simple. Body: Differentiated; stalk 3-5 celled, cells much longer than breadth, 2-3 cells longer than

upper 2 cells, lateral wall thin, smooth and straight, slightly swollen at joints, cross walls thin, lumen wide, content translucent; head 1-celled, globular, wall thick; content granulated dark yellowish. Distrib.: calyx, corolla. (Fig.85)

LAVANDULA BURMANI

It shows five type of trichomes. (Plate 21, Fig.86-90)

1. UNICELLULAR PAPILLOSE HAIR

Foot: Simple. Body: Entire, papillose, cell longer than width, wide base; tip obtuse; walls thin, rugose; lumen wide; content translucent. Distrib.: Calyx. (Fig.86)

2. UNICELLULAR CONICAL HAIR.

Foot: Simple. Body: Elongated, conical; pointed tip; walls thin, rugose, straight; lumen wide; content opaque. Distrib. Stem, petiole, leaf-surface, calyx, corolla. (fig.87).

3. UNICELLULAR HOOKED HAIR

Foot: Simple. Body: Entire, hooked, cell very long, acuminate, base arrect; tip pointed; walls thick, rugose, straight; lumen narrow; content opaque.

Explanation of the figures of Plate 21.

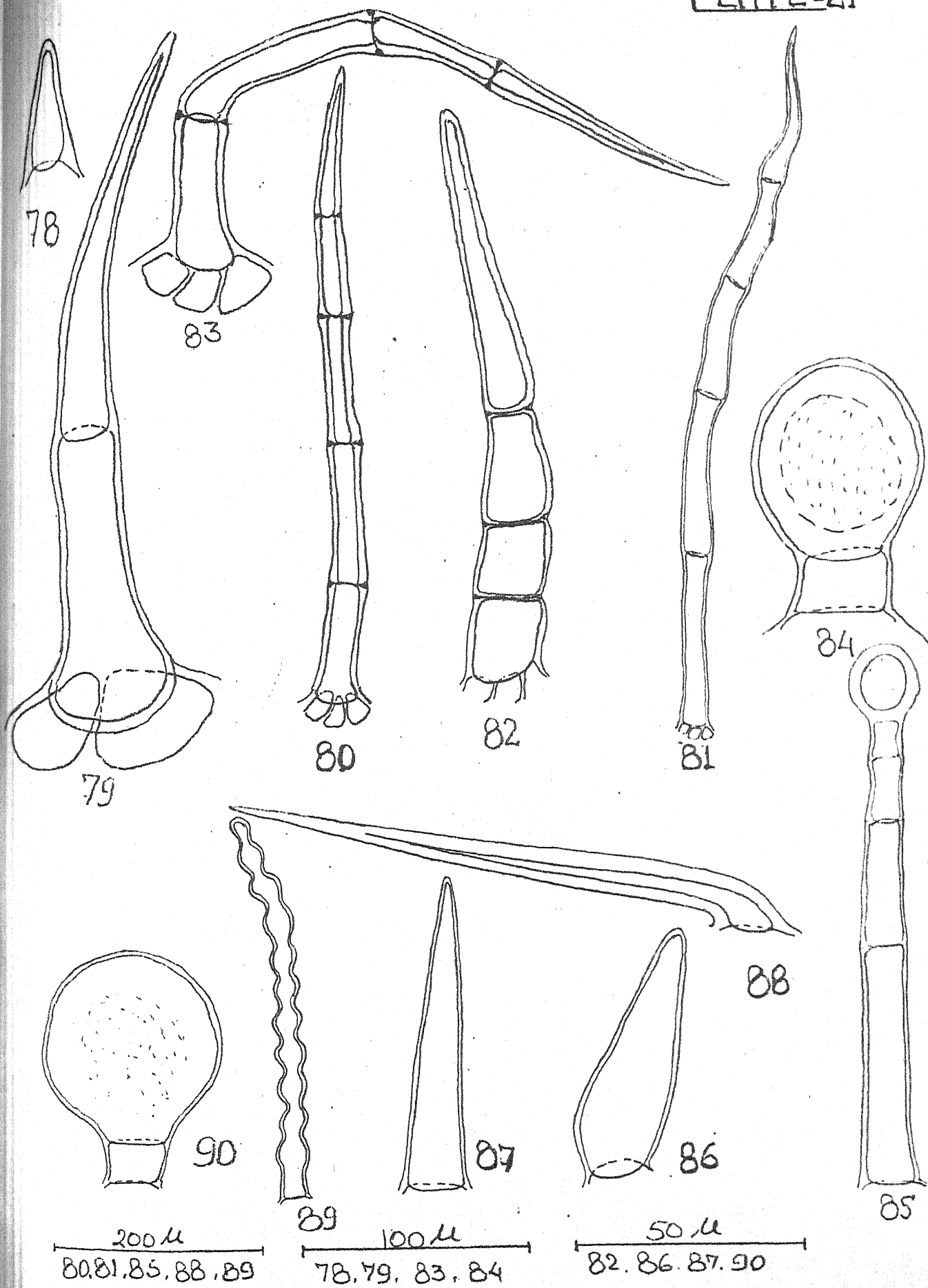
Trichomes from Various Plant parts.

Figs. 78 - 85 : Hyptis suaveolens.

Figs. 78, 80, 82	:	Calyx.
Fig. 79	:	Leaf upper.
Figs. 81, 85	:	Corolla.
Fig. 83	:	Stem.
Fig. 84	:	Bract.

Figs. 86 - 90 : Lavandula burmanni.

Fig. 86	:	Calyx.
Fig. 87	:	Leaf upper.
Fig. 88	:	Stem.
Fig. 89	:	Corolla.
Fig. 90	:	Stem.



Distrib. : Stem, petiole, leaf and calyx. (Fig.88)

4. UNICELLULAR TORRULOSE HAIR.

Foot: Simple. Body: elongated, torrulose, cells very long; tip obtuse; walls thin, rugose, wavy; lumen narrow; content translucent; Distrib. : Corolla. (Fig.89)

5. UNICELLULAR GLANDULAR CAPITATE HAIR

Foot: Simple. Body: Differentiated; stalk 1 celled, small, rectangular, walls, smooth, lumen wide, content translucent; head 1-celled, large, globular. wall thin, content light yellowish, granulated. Distrib.: Stem, leaf-upper surface, calyx. (Fig.90)

POGOSTEMON PARVIFLORUS

It shows nine type of trichomes. (Plate 22, Fig. 91-101)

1. UNICELLULAR PAPILLOSE HAIR

Foot: Simple. Body: Entire, elongated, papillose, base slightly bulbous; tip rounded; walls thick, smooth, straight; lumen wide; content translucent. Distrib.: Stem, leaf, Infl. axis, bract & calyx. (Fig.91)

2. UNICELLULAR FLAGELLATE HAIR.

Foot: Simple. Body: Long, irregularly flagellated with broad base (Fig.92) or very long, irregularly, flexuous, hyaline (Fig.93); pointed tip; walls thin, smooth; lumen wide or narrow; content translucent. Distrib. (Fig.92) - Leaf-margin, Infl. axis, bract & calyx; (Fig.93) - Corolla.

3. BICELLULAR FILIFORM HAIR.

Foot: Simple. Body: Entire, elongated, filiform, cells longer than breadth; tip obtuse; lateral walls thin, smooth & straight; cross wall thin; lumen wide; content translucent. Distrib. : Stem, Leaf- surface, Infl. axis, bract, calyx, corolla. (Fig.94)

4. BICELLULAR ASEPTATE FLAGELLATE HAIR

Foot: Simple. Body: 2 celled, differentiated; lower cells stout, erect; upper cell more elongated flagellate; tip pointed; lateral walls thin, smooth, swollen at joints; cross walls thin; lumen wide; content translucent. Distrib. : Stem, leaf, Infl. axis, bract and calyx. (fig.95).

5. BICELLULAR HOOKED HAIR.

Foot: Simple. Body: 2 celled, hooked, cells wide and

longer than breadth; tip pointed, lateral walls thick, smooth, swollen at joint; cross walls thick; lumen wide; content translucent. Distrib. : Stem, leaf, Infl. axis, bract and calyx. (Fig.96)

6. UNISERiate FILIFORM HAIR.

Foot: Simple. Body: 3-12 celled, entire, very long, filiform, cells longer than breadth; tip pointed; lateral wall thin, smooth; cross walls thin; lumen narrow; content opaque. Distrib. : Stem, leaf-lower surface, Infl.axis, bract, calyx and Corolla.(Fig.97)

7. UNISERiate HOOKED HAIR

Foot: Simple. Body: 3-5 elongated, hooked, cells longer than breadth; tip pointed; lateral walls thick or thin, smooth, slightly swollen at joints; cross walls thin; lumen wide; content translucent. Distrib. : Stem, leaf-lower surface & margin, Infl. axis, bract calyx and corolla. (Fig.98)

8. UNICELLULAR GLANDULAR CAPITATE HAIR

Foot: Simple. Body: Differentiated; stalk 1 celled, rectangular, short, walls thin & smooth, lumen wide, content translucent; head 1-celled, large, capitate, globose, (Fig. 99) or oblong (Fig.100), thin walled, content dense granulated or opaque. Distrib.: Fig.99

- Stem, leaf, Infl. axis; Fig.100 - Stem, Infl. axis.

9. UNISERiate GLANDULAR CAPITATE HAIR

Foot: Simple. Body: Differentiated; stalk 3-4 celled, cells rectangular and longer than breadth, except the uppermost cell, lateral & cross wall thin, smooth, straight, lumen wide, content translucent; head 1-celled, globose, capitate, wall thin, content dense, granulated. Distrib.: Stem, leaf-margin, Infl. axis, bract, calyx, corolla. (Fig.101)

POGOSTEMON PLECTRANTHOIDES

It shows sixteen type of trichomes. (Plate 22-23, Fig. 102-117)

1. UNICELLULAR PAPILLOSE HAIR

Foot: Simple. Body: Entire, elongated, papillose; tip rounded; walls thin and smooth, straight; lumen wide; content translucent. Distrib.: Leaf lower surface, Infl. axis. (Fig.102)

2. UNICELLULAR FLAGELLATE HAIR.

Foot: Simple. Body: Elongated, flagellate; obtuse tip; walls thin, smooth, wavy; lumen wide; content translucent. Distrib. Petiole, leaf, Infl. axis,

bract and calyx. (fig.103).

3. UNICELLULAR CONICAL HAIR.

Foot: Simple. Body: Entire, long, conical, base wide gradually tapering to a pointed apex, walls thick, smooth & straight; lumen wide; content translucent. Distrib. : Stem, petiole, leaf, Infl.axis., bract and calyx. (fig.104).

4. UNICELLULAR HOOKED HAIR.

Foot: Simple. Body: 1-celled, hooked, cell longer than breadth; tip pointed; walls thick, smooth, lumen narrow; content opaque. Distrib. : Bract & calyx. (fig.105)

5. UNICELLULAR DENTATE HAIR.

Foot: Simple. Body: 1-celled, entire, dentate, base broad; sharply tapering to a pointed apex; walls thick, smooth, straight; lumen wide; content opaque. Distrib. : Bract & calyx. (fig.106)

6. UNICELLULAR TORRULOSE HAIR.

Foot: Simple. Body: Elongated, torrulose; pointed tip; walls thin, smooth, wavy; lumen irregularly-narrow; content translucent. Distrib. Corolla. (fig.107).

Explanation of the figures of Plate 22.

Trichomes from Various Plant parts.

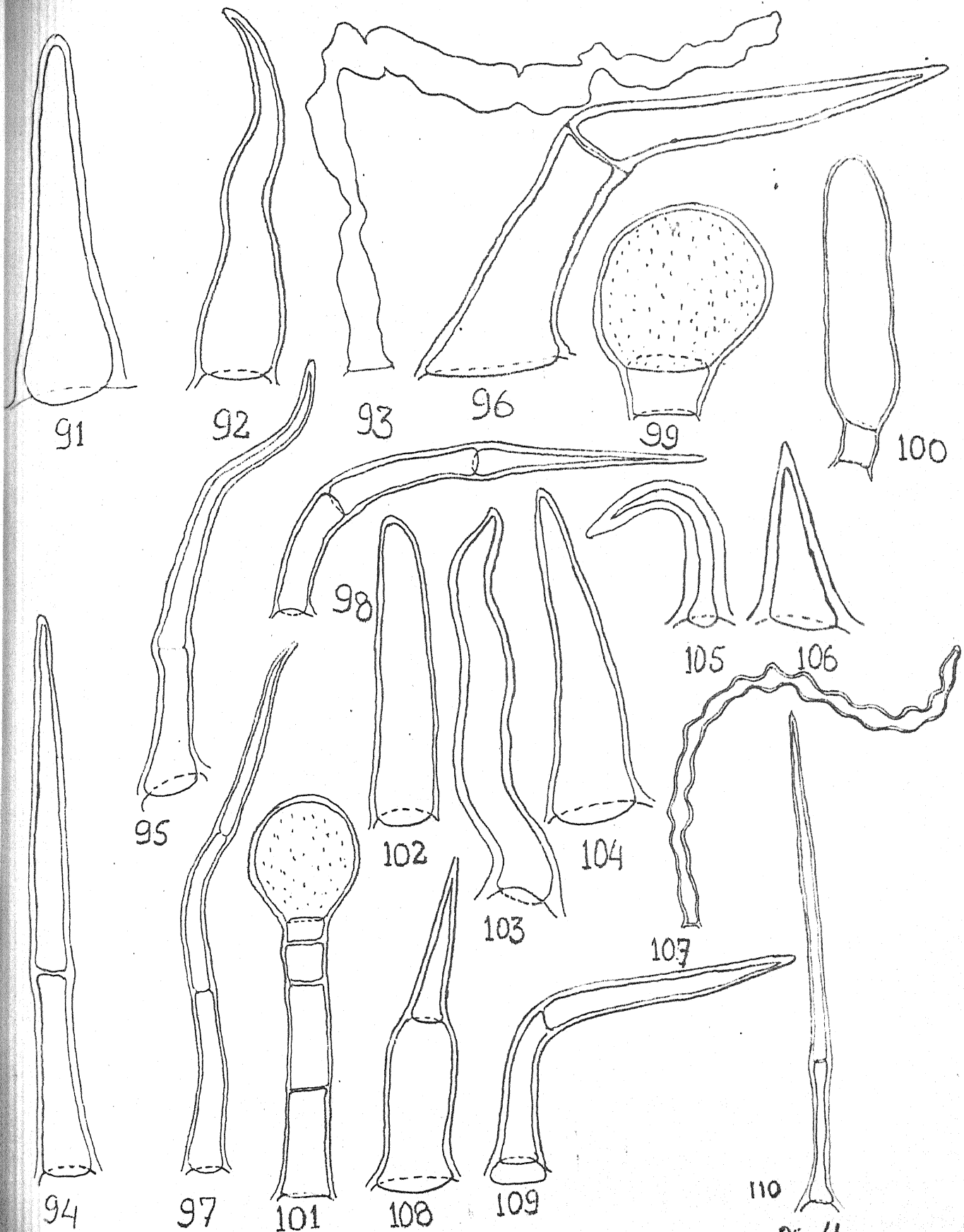
Figs. 91 - 101 : Pogostemon parviflorus.

Figs. 91, 94, 95, 96,	:	Stem.
99, 100, 101	:	
Figs. 92, 98	:	Infl. axis.
Figs. 93, 97	:	Corolla.

Figs. 102 - 110 : Pogostemon plectranthoides

Figs. 102, 104	:	Leaf upper.
Fig. 103	:	Petiole.
Figs. 105, 106, 109	:	Bract.
Fig. 107	:	Corolla
Fig. 108	:	Leaf lower.
Fig. 110	:	Stem.

PLATE-22



100 μ
98, 103, 07, 10

100 μ
93, 95, 97, 100, 101

92, 94, 96, 104, 05, 08, 09

25 μ
91, 99, 102, 06,

7. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: 2-celled, conical; cells of equal size; basal cell broad and long; upper cell sharply acuminate; tip pointed; lateral walls thick, smooth; cross wall thin; lumen wide; content translucent. Distrib. : leaf-surface, & Infl. axis. (fig.108)

8. BICELLULAR HOOKED HAIR

Foot: Simple. Body: Elongated, hooked; cells longer than breadth, upper cell longer than basal one; tip pointed; lateral walls thick, smooth; cross wall thin; lumen wide; content translucent. Distrib. : Stem, leaf-lower surface, bract, corolla and calyx. (fig.19)

9. BICELLULAR ACUMINATE HAIR.

Foot: Simple. Body: 2-celled, long, acuminate cells, narrowly elongated; tip acuminate; wall thin, smooth, straight; lumen wide; content opaque; Distrib. : Stem, petiole, leaf, Infl. axis, bract & calyx. (Fig.110)

10. BICELLULAR ASEPTATE FLAGELLATE HAIR.

Foot: Simple. Body: 2-celled, very long, differentiated, basal cell long, base broad; upper

cell narrowly flagellate; tip sharply pointed; lateral walls thin, smooth, swollen at joints; cross wall thin; lumen narrow; content translucent. Distrib. : Stem, leaf, Infl. axis, bract & calyx. (Fig.111)

11. UNISERiate SEPTATE FLAGELLATE HAIR.

Foot: Simple. Body: 3-8 celled, elongated, septate, flagellate, cells much longer than breadth, cells of varied length; tip pointed; lateral wall thin, smooth; cross walls thin; lumen wide; content translucent Distrib. : Stem, petiole, leaf-lower surface, Infl. axis. (Fig.112)

12. UNISERiate CYLINDRICAL HAIR.

Foot: Simple. Body: 3-4 celled, entire, elongated, cylindrical cells, longer than breadth, joints articulated; tip rounded, lateral wall thick, smooth, straight; cross wall thin; lumen narrow; content translucent. Distrib. : Stem. (Fig.113)

13. UNISERiate ACERATE HAIR

Foot: Simple. Body: 3-6 celled, elongated, acerate, cells narrow, more longer than width; tip pointed; lateral & cross walls thin, smooth, straight, swollen

at joints; lumen narrow; content opaque. Distrib. :
Stem, petiole, leaf, Infl. axis, bract, calyx &
corolla. (Fig.114)

14. UNICELLULAR GLANDULAR CAPITATE HAIR

Foot: Simple. Body: Differentiated; stalk 1-celled, rectangular cell wider than length, wall thin and smooth, lumen wide, content translucent; head 1-celled, globose, prominent, wall thin, content light yellow granular. Distrib.: Stem, petiole, leaf-surface, Infl. axis, bract & calyx. (Fig.115)

15. BICELLULAR GLANDULAR CAPITATE HAIR

Foot: Simple. Body: Differentiated; stalk 2-celled, erect, basal cell more longer and translucent; upper cell rectangular and opaque, wall thin; head 1-celled, large, globular, wall thin; content granulated. Distrib.: Stem, petiole, leaf, Infl. axis, bract, calyx. (Fig.116)

16. UNISERIATE GLANDULAR CAPITATE HAIR

Foot: Simple. Body: Differentiated; stalk 2-5 celled, flexuous, cells more longer than breadth, wall thin, smooth, swollen at joints, lumen narrow, content translucent except the upper most dwarf cell; head 1-celled, large, globose, wall thin, content light

Explanation of the figures of Plate 23.
Trichomes from Various Plant parts.

Figs. 111 -117 Pogostemon plectranthoides

Figs. 111, 112, 113, : Stem.
114, 115, 116

Fig. 117 : Calyx.

Figs. 118-120: Colebrookia oppositifolia.

Figs. 118, 120 : Ovary wall.

Figs. 119, 125 : Leaf upper.

Figs. 121 : Leaf lower.

Figs. 122 : bract.

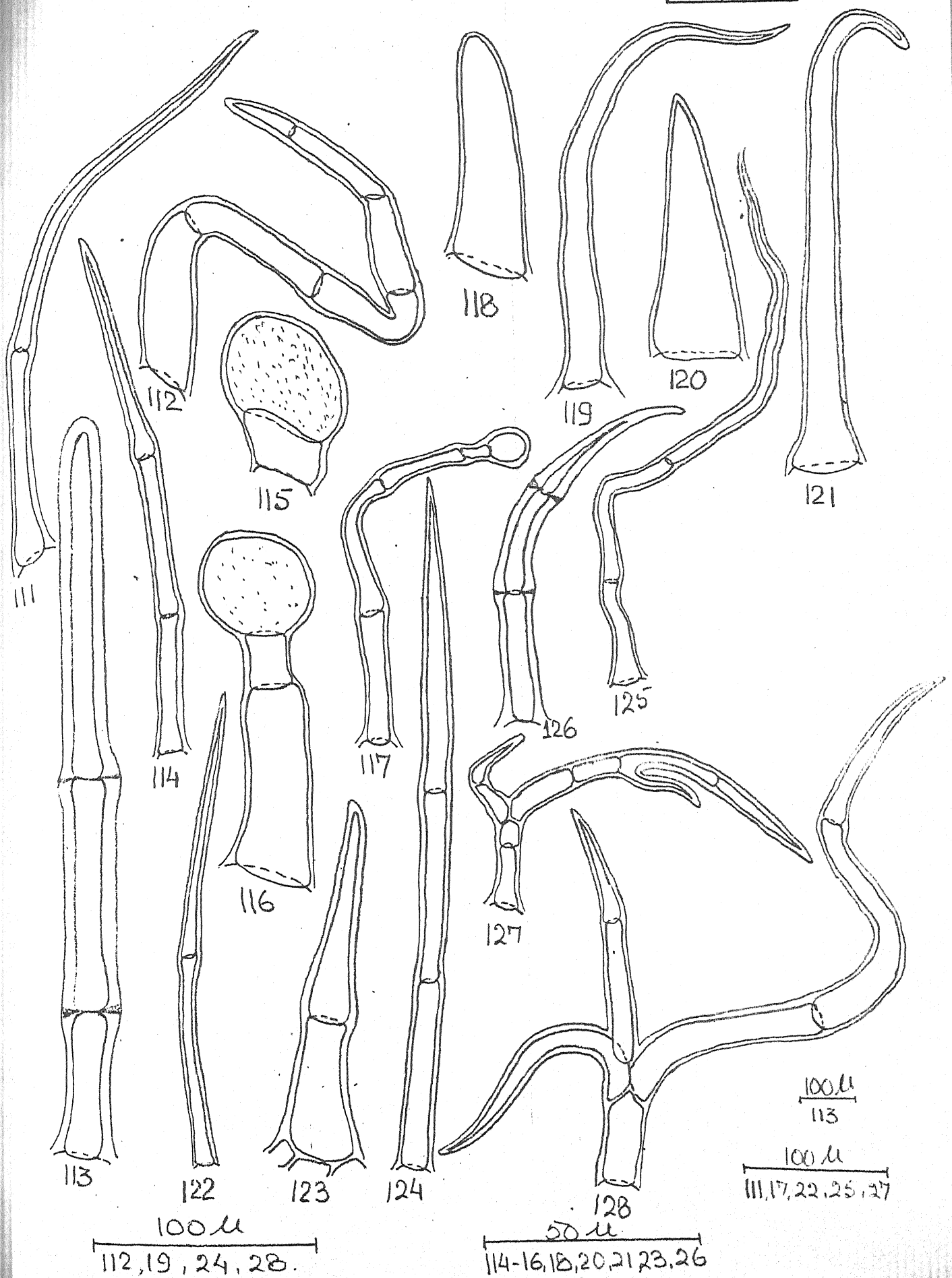
Figs. 123, 128 : Infl. axis.

Figs. 124 : Corolla.

Fig. 126 : Leaf margin.

Fig. 127 : Stem.

PLATE-23



yellow. Distrib.: leaf-surface, Infl. axis, calyx.
(Fig.117)

COLEBROOKIA = OPPOSITIFOLIA

It shows fifteen type of trichomes. (Plate 23-24,
Fig. 118-132)

1. UNICELLULAR PAPILLOSE HAIR

Foot: Simple. Body: Oblong, papillose, cells longer than breadth; tip rounded; walls thin and smooth; lumen wide; content opaque. Distrib.: Ovary wall.
(Fig.118)

2. UNICELLULAR FLAGELLATE HAIR.

Foot: Simple. Body: Entire, elongated, flagellate, cell narrow and very long; pointed tip; walls thin, smooth; lumen narrow; content opaque. Distrib. :
Leaf-surface, infl. axis and ovary wall. (fig.119).

3. UNICELLULAR CONICAL HAIR.

Foot: Simple. Body: Entire, long, conical, cell more elongated than breadth; tip pointed; walls thick, smooth & straight; lumen wide; content translucent.
Distrib. Leaf & ovary wall. (fig.120).

4. UNICELLULAR HOOKED HAIR.

Foot: Simple. Body: 1-celled, elongated, ancholar, cell much elongated with abruptly turned apex; tip pointed; walls thin, smooth & straight; lumen narrow; content opaque. Distrib. : Leaf upper surface. (fig.121)

5. BICELLULAR FILIFORM HAIR.

Foot: Simple. Body: Entire, elongated, filiform, cells of equal size and much longer than breadth; tip pointed; walls thin, smooth, straight; lumen narrow; content opaque. Distrib. : Bract. (fig.122)

6. BICELLULAR CONICAL HAIR.

Foot: Compound. Body: 2-celled, conical, elongated, cells longer than breadth; tip obtuse; lateral walls thick, smooth, straight, swollen at joint; cross wall thin; lumen wide; content translucent. Distrib. : Stem, petiole, leaf, infl. axis. (Fig.123)

7. UNISERIATE FILIFORM HAIR.

Foot: Simple. Body: 3-6 celled, entire, elongated, cells much elongated than breadth; tip pointed; lateral wall thin, smooth, straight; cross wall thin; lumen narrow; content translucent. Distrib. : Stem, petiole, leaf, infl. axis, bract and corolla. (Fig.124)

8. UNISERiate SEPTATE FLAGELLATE HAIR.

Foot: Simple. Body: 3-4 celled, very long, flexuous, cells much longer than breadth, apical cell longest; tip pointed; lateral & cross wall thin, smooth, wavy; lumen narrow; content opaque Distrib. : Leaf, Infl. axis. (Fig.125)

9. UNISERiate CURVED HAIR.

Foot: Simple. Body: 3-4 celled, entire, curved, cells longer than breadth; tip pointed; lateral walls thick, smooth, swollen at joints; cross walls thin; lumen narrow; content opaque. Distrib. : Leaf-margin. (Fig.126)

10. UNISERiate BRANCHED HAIR.

Foot: Simple. Body: 5-10 celled, branched into uniseriate filiform arms; forking from the basal region, cells of varied length; lateral walls thin, smooth, straight; cross wall thin; lumen wide; content opaque. Distrib. : Stem, petiole, leaf, infl. axis, bract. (Fig.127)

11. STELLATE TRIRADIATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, stout, erect, cells longer than breadth; head

triradiate, usually rays uniseriate, sometimes unicellular; cells elongated and longer than breadth; lateral walls thin, smooth; cross wall thin; content opaque. Distrib. : Stem, & infl. axis, (Fig.128)

12. STELLATE BIRADIATE HAIR.

Foot: Compound. Body: Differentiated; stalk 2-celled, erect, cells of equal size; head biradiate, rays, multicellular, uniseriate filiform, cells elongated; tip pointed; lateral & cross walls thin, smooth, content opaque. Distrib. : Stem, petiole, leaf, infl. axis, calyx. (Fig.129)

13. UNICELLULAR GLANDULAR CAPITATE HAIR

Foot: Simple. Body: Differentiated; stalk 1-celled, short, rectangular wall thin and smooth, content translucent; head 1-celled, large, globose, wall thin, content dense granulated. Distrib.: Stem, petiole, leaf-surface, Infl. axis. (Fig.130)

14. BICELLULAR GLANDULAR CAPITATE HAIR

Foot: Compound. Body: Differentiated; stalk 2-celled, erect, cells of varied length, lower cell more elongated, walls thin, smooth, straight, content translucent except in upper cell; head 1-celled, oval, small, wall thin; content dense granulated.

Distrib.: Stem, petiole, leaf, Infl. axis & bract.
(Fig.131)

15. UNISERIATE GLANDULAR CAPITATE HAIR

Foot: Compound. Body: Differentiated; stalk 3-4 celled, erect, gradually tapering, cells more longer than breadth, wall thin, smooth, straight, lumen wide, content translucent except the upper most cell; head 1-celled, large, globose, wall thin, content dense granular. Distrib.: Leaf margin, Infl. axis & bract. (Fig.132)

ELSHOLTZIA - POLYSTACHYA

It shows eight type of trichomes. (Plate 24, Fig. 133-140)

1. UNICELLULAR DENTATE HAIR.

Foot: Simple. Body: 1-celled, entire, dentate, cell more elongated than breadth; pointed apex; walls thin, smooth; lumen wide; content translucent. Distrib. : Leaf-margin & calyx. (fig.133)

2. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: 2-celled, entire, long, conical,

basal cell small, rectangular, upper cell elongated, tip pointed, lateral walls thin, smooth & straight; cross wall thin; lumen wide; content translucent. Distrib. Stem, leaf, upper-surface & margin, calyx. (fig.134).

3. BICELLULAR HOOKED HAIR.

Foot: Simple. Body: 2-celled, hooked, basal cell dome shaped, apical cell elongated and hooked; tip pointed; lateral & cross walls thin, smooth, convex; lumen wide; content translucent. Distrib. : Leaf-lower surface, infl. axis & calyx. (fig.135)

4. UNISERIATE CONICAL HAIR.

Foot: Simple. Body: 3-8 celled, entire, dwarf, erect, conical, cells wide, rectangular except terminal elongated one, tip pointed; lateral & cross walls thin, smooth, constricted at joints; lumen wide; content translucent Distrib. : Stem, leaf, calyx & corolla. (Fig.136)

5. UNISERIATE CURVED HAIR.

Foot: Simple. Body: 3-6 celled, elongated, curved, cells longer than breadth, joints, base broad; tip pointed; lateral & cross walls thin, smooth; lumen

Explanation of the figures of Plate 24.

Trichomes from Various Plant parts.

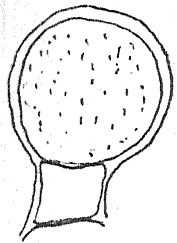
Figs. 129 - 132: Colebrookia oppositifolia.

Figs. 129, 130, 131	:	Stem.
Fig. 132	:	Infl. axis.

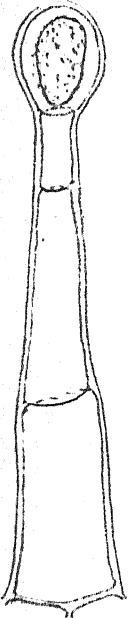
Figs. 133-140: Elsholtzia polystachya.

Figs. 133, 135, 138, 139	:	leaf margin.
Fig. 134	:	Stem.
Figs. 136, 137, 140	:	leaf lower.

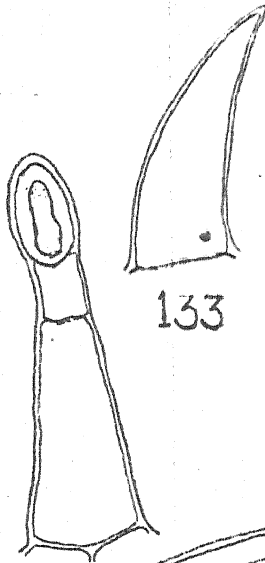
PLATE-24



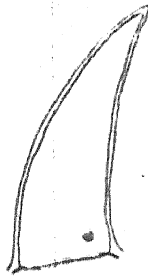
130



132



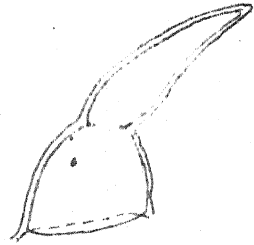
131



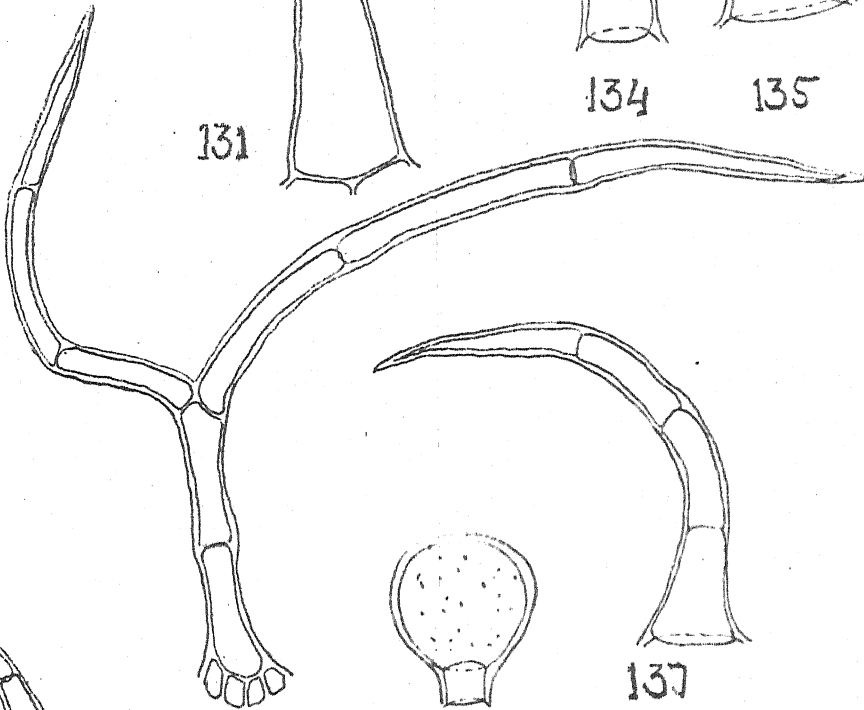
133



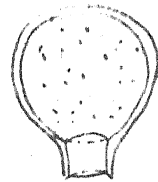
134



135

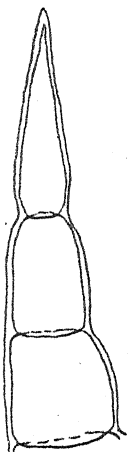


129

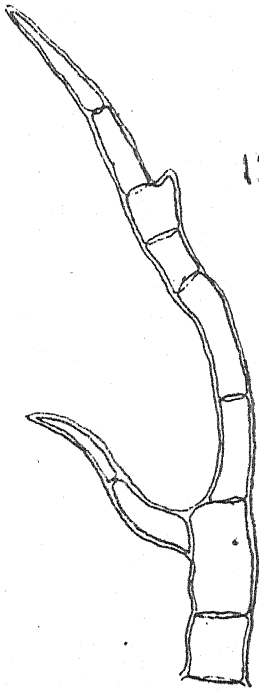


140

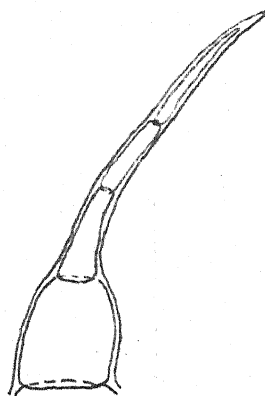
137



136



139



138

$\frac{100 \mu}{129}$

$\frac{100 \mu}{133, 135-140}$

$\frac{50 \mu}{130-132, 134}$

wide; content translucent. Distrib. : Leaf-surface & corolla. (Fig.137)

6. UNISERiate ACUMINATE HAIR

Foot: Simple. Body: 3-6 celled, differentiated, cells narrow & elongated except basal bulbous cell; tip pointed; lateral & cross walls thin, smooth, lumen wide & narrow; content opaque. Distrib. : Leaf, calyx & corolla. (Fig.138)

7. UNISERiate BRANCHED HAIR.

Foot: Simple. Body: Multicellular, uniseriate branched; branch arises alternately from distal part of the cell, cells of varied length; tip pointed; lateral & cross walls thin; lumen narrow; content opaque. Distrib. : Leaf-lower surface & margin, calyx & corolla. (Fig.139)

8. UNICELLULAR GLANDULAR CAPITATE HAIR

Foot: Simple. Body: Differentiated; stalk 1-celled, short, rectangular, wall thin, content translucent; head 1-celled, large, globose, wall thin, content dense granular. Distrib.: Leaf & calyx. (Fig.140)

ELSHOLTZIA STROBILIFERA

This species shows ten type of trichomes. (Plate 25, Fig. 141-150)

1. UNICELLULAR CONICAL HAIR.

Foot: Simple. Body: Entire, stout, conical, cell small, triangular; tip pointed; walls thick, rugose, straight; lumen wide; content translucent. Distrib. Leaf-margin, bract, calyx & corolla. (fig.141).

2. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: Entire, conical; basal cell wide, elongated, tip pointed; lateral walls thick; rugose, cross wall thin; lumen wide; content translucent. Distrib. : Leaf-margin, bract, calyx & corolla. (Fig.142)

3. BICELLULAR HOOKED HAIR

Foot: Simple. Body: 2-celled, hooked, basal cell wide, rectangular & arrect, upper cell turn aside; tip pointed; lateral walls thick, rugose; cross wall thin; lumen varies; content opaque. Distrib. : Stem, petiole, leaf-upper surface & margin bract and calyx. (Fig.143)

4. UNISERiate FILIFORM HAIR.

Foot: Simple. Body: 3-6 celled, entire, elongated, filiform, cells longer than breadth; tip pointed; lateral & cross wall thin, rugose, constricted at joints; lumen wide; content translucent. Distrib. : Stem, petiole, leaf. (Fig.144)

5. UNISERiate SEPTATE FLAGELLATE HAIR.

Foot: Simple. Body: 3-8 celled, very long, septate, flagellate, cells of varied size & more longer than width; tip pointed; lateral and cross walls thin, rugose, flexuous; lumen wide; content translucent. Distrib. : Bract, calyx & corolla. (Fig.145)

6. UNISERiate CURVED HAIR.

Foot: Simple. Body: 3-6 celled, entire, elongated, curved, cells of varied length, upper cell longer; tip pointed; lateral & cross wall thin, rugose; lumen wide; content translucent. Distrib. : Stem, petiole, leaf margin & bract. (Fig.146)

7. UNISERiate HOOKED HAIR.

Foot: Simple. Body: 3-5 celled, entire, hooked, cells longer than breadth, upper cell elongated & tapering into a pointed tip; lateral & cross walls thin, rugose, lumen wide; content translucent. Distrib. :

Stem. (Fig.147)

8. UNISERiate ACUMINATE HAIR.

Foot: Compound. Body: 3-9 celled, entire, elongated, acuminate, cells longer than breadth, pointed tip; lateral walls thin, rugose, straight; cross wall thin; lumen wide; content opaque. Distrib. : Bract, calyx & corolla. (Fig.148)

9. PELTATE HAIR.

Foot: Not visible. Body: Multicellular, shield like, circular in shape, parallel to epidermis, 1 cell thick, 5-8 cell in diameter; cells radiating from center; hollow center, outer walls thin, smooth, cutinised; lateral walls thin, hyaline; content dense, Distrib. : Stem & petiole. (Fig.149)

10. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, small, rectangular, walls thin, content translucent; head 1-celled, globose, capitate, wall thin; content dense (Dark yellowish green). Distrib.: Leaf-upper surface, bract, calyx & corolla. (Fig.150)

MENTHA ARVENSIS

This species shows six type of trichomes (Plate 25 fig. 151-156)

1. UNICELLULAR PAPILLOSE HAIR.

Foot : Simple. Body : Entire, oblong, hyaline, papillose; tip obtuse; walls thin, smooth, convex; lumen wide; content translucent. Distrib. : Stem, petiole, leaf-margin & corolla. (Fig. 151)

2. UNICELLULAR DENTATE HAIR.

Foot : Simple. Body : entire, stiff, dentate, cell longer than breadth; tip pointed; wall thin, smooth, turn aside; lumen wide; content translucent. Distrib. : Leaf-margin (Fig. 152)

3. BICELLULAR CONICAL HAIR.

Foot : Simple. Body : 2-celled, stout, conical, cells longer than breadth & of equal size, tip pointed; lateral wall thick, smooth, constricted at joints; cross wall thick; lumen wide; content translucent. Distrib. : Stem, petiole, leaf-margin, calyx & corolla. (Fig. 153)

4. UNISERiate CONICAL HAIR.

Foot : Simple. Body : 4-12 celled, entire, elongated,

conical, cells oval; tip pointed; lateral walls thin, smooth, convex, constricted at joints; cross walls thin; lumen wide; content translucent. Distrib. : Stem, petiole, leaf, calyx and corolla. (Fig. 154)

5. PELTATE HAIR.

Foot : Not visible. Body : 6-10 celled, 1-celled thick, peltate; cells rectangular, radially arranged; walls thin, periphery smooth; content opaque granular. Distrib. : Stem, petiole, leaf-surface. (Fig. 155)

6. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 1-celled, rectangular, small, thin walled, content translucent; head 1-celled, large, globose, thin walled, content opaque. Distrib. : Stem, petiole, leaf upper surface. (Fig. 156)

MENTHA SPICATA

This species shows five type of trichomes (Plate 25 fig. 157-161)

1. UNICELLULAR PAPILLOSE HAIR.

Foot : Simple. Body : Entire, papillose, cell long &

Explanation of the figures of Plate 25.

Trichomes from Various Plant parts.

Figs. 141 - 150: Elsholtzia polystachya.

Figs. 141, 145, 148	:	Bract.
Figs. 142, 143	:	leaf margin.
Figs. 144, 146, 147, 149	:	Stem.
Fig. 150	:	Leaf upper.

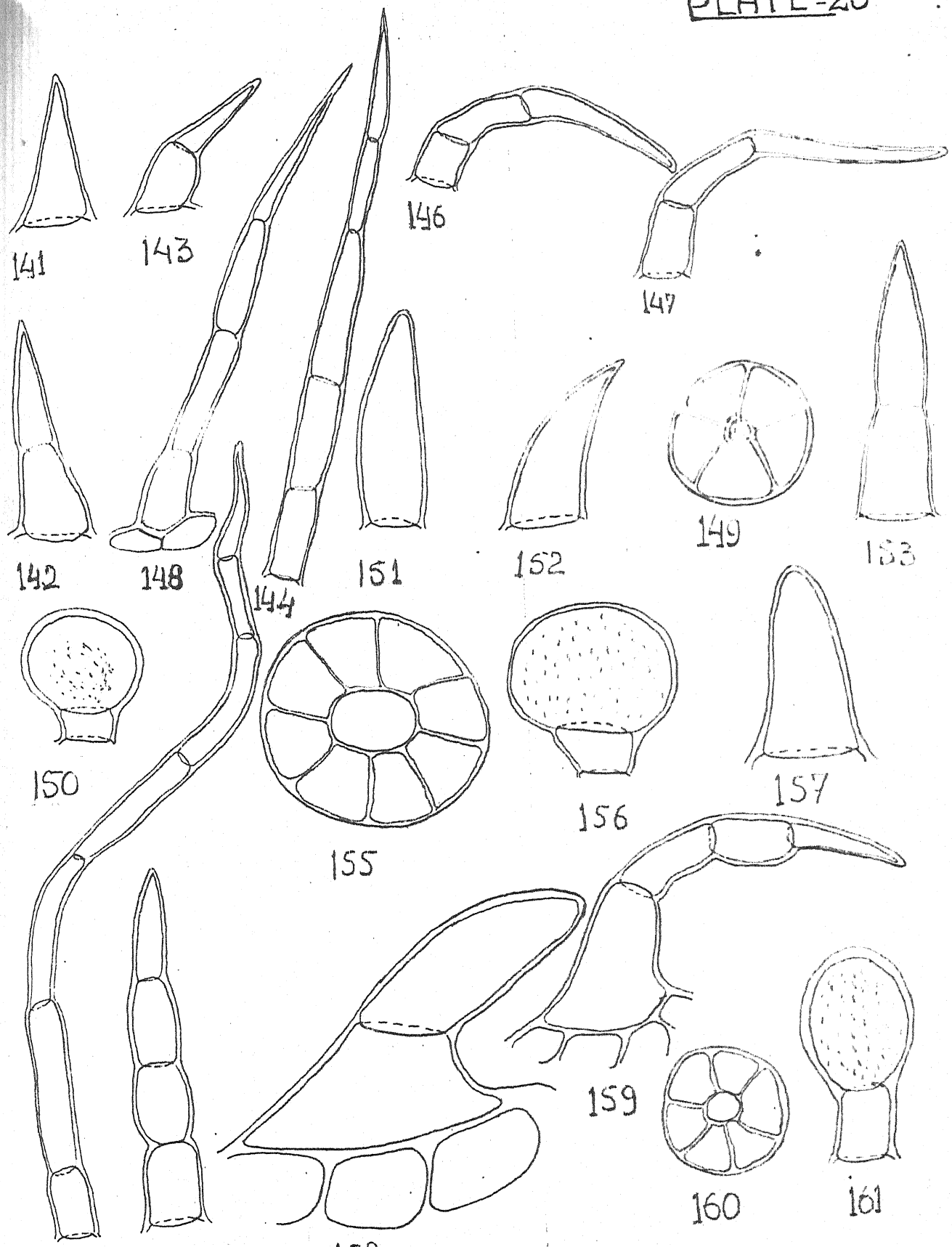
Figs. 151 - 156: Mentha arvensis.

Figs. 151, 152	:	leaf margin.
Figs. 153, 155, 156	:	Stem.
Fig. 154	:	Leaf lower.

Figs. 157 - 161 : Mentha spicata

Figs. 157, 158, 159	:	Brct.
Figs. 160, 161	:	Stem.

PLATE-25



100 μ 100 μ 50 μ 50 μ
 146, 54 142-45, 47-50 141, 59 151-53, 55-58, 60, 61

wide; tip rounded; walls thin, rugose; lumen wide; content translucent. Distrib. : Bract, calyx, corolla. (Fig. 157)

2. BICELLULAR HOOKED HAIR.

Foot : Compound. Body : 2-celled, entire, hooked, basal cell spreaded and wider than length, upper cell elongated and bend to form hook; tip rounded; lateral wall thick, rugose; cross wall thick; lumen wide; content translucent. Distrib. : Leaf-margin, bract, calyx & corolla. (Fig.158)

3. UNISERIATE HOOKED HAIR.

Foot : Compound. Body : 3-4 celled, stiff, hooked, cells oval except basal erect, oblong one; tip pointed; lateral wall thick, rugose; cross wall thin; lumen wide; content opaque. Distrib. : Bract. (Fig.159)

5. PELTATE HAIR.

Foot : Not visible. Body : 1-celled thick, peltate, having 6-8 cells around the center, cells radiating, cells rectangular, walls thin, periphery smooth; lumen wide; content translucent. Distrib. : Stem, petiole, leaf-surface, Infl.axis, calyx & corolla. (Fig. 160)

6. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 1-celled, rectangular, small, thick walled and smooth, lumen wide, content translucent; head 1-celled, oval, large, thick walled, content granulated golden yellow. Distrib. : Stem, petiole, leaf, Infl. axis, bract, calyx & corolla. (Fig. 161)

ORIGANUM VULGARE

This plant shows eight type of trichomes (Plate 26 fig. 162-169)

1. UNICELLULAR CONICAL HAIR.

Foot : Simple. Body : Entire, elongated, conical, cell much longer than breadth; tip obtuse; walls thick, smooth, convex one side; lumen wide; content translucent. Distrib. : Leaf-margin. (Fig. 162)

2. BICELLULAR CONICAL HAIR.

Foot : Simple. Body : Entire, stiff, erect, conical, cells of equal size, upper cell sharply tapering to a pointed tip; lateral walls thick, smooth, constricted at joint; cross wall thick; lumen wide; content translucent. Distrib. : Infl. axis, calyx. (Fig. 163)

3. BICELLULAR HOOKED HAIR.

Foot : Compound. Body : Entire, hooked, cells of equal size; basal cell erect, base broad; terminal cell turn aside; tip pointed, lateral & cross walls thick, smooth, swollen at joints; lumen narrow; content opaque. Distrib. : Leaf margin, Infl. axis. (Fig. 164)

4. UNISERiate CONICAL HAIR.

Foot : Simple. Body : 3-5 celled, erect, elongated, conical, cells longer than breadth except lowermost cell, cells gradually tapering above; tip pointed; lateral & cross walls thin, smooth; lumen wide; content translucent. Distrib. : Corolla. (Fig. 165)

5. UNISERiate CURVED HAIR.

Foot : Compound. Body : 3-4 celled, entire, curved, cells longer than breadth; tip pointed; lateral & cross walls thick, smooth, joints thick, prominent; lumen wide; content opaque. Distrib. : Stem, Infl. axis, corolla. (Fig. 166)

6. UNISERiate ACUMINATE HAIR.

Foot : Simple. Body : 3-6 celled, entire, long, acuminate, cells narrow and longer than breadth; tip

pointed; lateral & cross walls thin, smooth, straight; lumen narrow; content translucent. Distrib. : Calyx & corolla. (Fig. 167)

7. PELTATE HAIR.

Foot : Not visible. Body : Multicellular, 8 celled in diameter, 1-celled thick, cells large, rectangular, arranged around the center; walls thick, periphery thick & smooth; lumen wide; content translucent. Distrib. : Stem, leaf-surface, Infl. axis, bract, calyx & corolla. (Fig. 168)

8. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 1-celled, short, collared, rectangular, thin walled, content translucent; head 1-celled, large, prominent, globose, thin walled, content dense. Distrib. : Stem, leaf, bract. (Fig. 169)

THYMUS SERPYLLUM

This species shows eleven type & trichomes. (Plate 26, Fig. 170-181)

1. UNICELLULAR PAPILLOSE HAIR.

Foot: Simple. Body: 1-celled, dwarf (Fig. 170) or

long, tubular (Fig. 171); tip obtuse; walls thin, rugose; lumen wide; content translucent. Distrib. : (Fig.170) Stem, leaf & calyx; (Fig.171) Corolla & stamen (filament).

2. UNICELLULAR DENTATE HAIR.

Foot: Simple. Body: 1-celled, entire, dentate, cell longer than breadth; tip pointed; walls thin, rugose, slightly turn aside; lumen wide; content opaque. Distrib.: Leaf margin, & calyx. (Fig.172)

3. BICELLULAR FILIFORM HAIR.

Foot: Simple. Body: Entire, elongated, filiform; cells much longer than breadth; tip obtuse; lateral walls thin, rugose, straight; cross walls thin; lumen wide; content translucent. Distrib. Stamen (filament). (fig.173).

4. BICELLULAR SEPTATE FLAGELLATE HAIR.

Foot : Simple. Body : 2-celled, elongated, hyaline, flagellate; cells long and flexuous, upper cell more elongated; tip obtuse; lateral walls thin, rugose; cross wall thin; lumen wide; content translucent; Distrib. : Leaf-margin, & corolla. (Fig. 174)

5. BICELLULAR CONICAL HAIR.

Foot: Compound. Body: 2-celled, entire, stout, conical; cells longer than breadth; pointed tip; lateral walls thick, rugose; straight, joint prominent; cross walls thin; lumen wide; content opaque. Distrib. : Stem, and calyx. (fig.175)

6. BICELLULAR HOOKED HAIR.

Foot: Compound. Body: Entire, elongated, hooked, cells much longer than breadth; basal cell turn aside, tip pointed, lateral walls thick, rugose; cross wall thin; lumen wide; content opaque. Distrib. : Stem, leaf-margin, and calyx (Fig.176)

7. UNISERIATE FILIFORM HAIR.

Foot: Compound. Body: 3-5 celled, entire, elongated, filiform; cells longer than breadth; tip pointed; lateral walls thin, rugose, straight; cross walls thin; lumen wide & narrow; content opaque. Distrib. : Leaf-margin and corolla. (Fig.177)

8. UNISERIATE CONICAL HAIR.

Foot: Compound. Body: 3-4 celled, entire, elongated, conical, cells articulate; tip pointed; lateral walls thick, rugose, straight, swollen at joints; cross walls thin; lumen wide; content translucent. Distrib.

Explanation of the figures of Plate 26.

Trichomes from Various Plant parts.

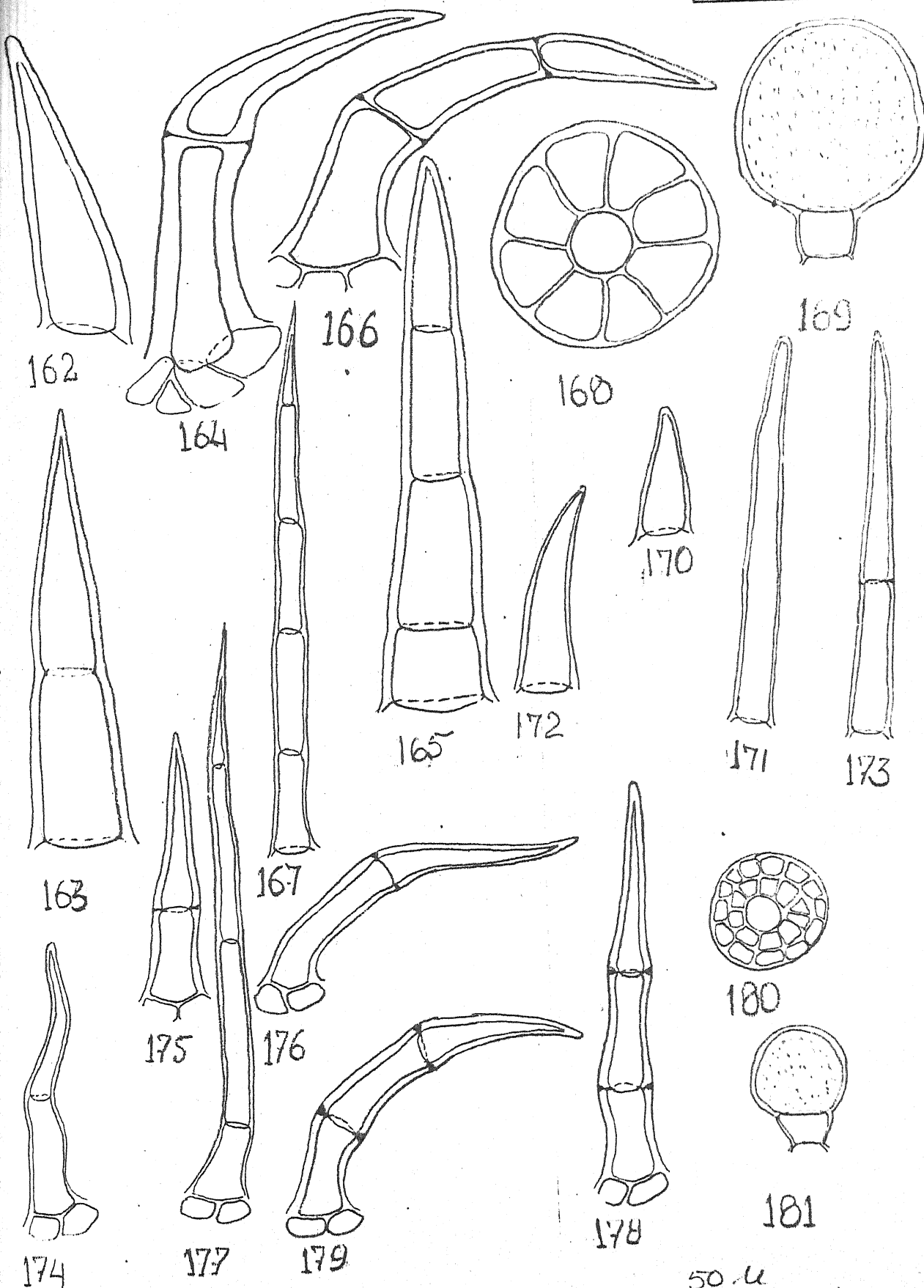
Figs. 162 - 169: Origanum vulgare.

Figs. 162, 164, 167	:	leaf margin.
Fig. 163	:	Infl. axis.
Fig. 165	:	Calyx.
Fig. 166	:	Corolla
Figs. 168, 169	:	Stem.

Figs. 170 - 181 : Thymus serpyllum.

Fig. 170	:	Leaf upper.
Fig. 171	:	Corolla
Figs. 172, 174, 177	:	leaf margin.
Fig. 173	:	Staminal filament.
Figs. 175, 176, 178, 179, 180, 181	:	Stem.

PLATE-26



100 μ .
167, 71, 73, 77

200 μ .
164, 66, 74-76, 78-80, 81

50 μ .
162, 63, 65, 68-70, 72

: Stem, calyx. (Fig.178)

9. UNISERiate HOOKED HAIR.

Foot: Compound. Body : 3-8 celled, entire, hooked; cells longer than breadth; tip pointed; lateral walls thick, rugose, straight, swollen at joints, cross walls thin; lumen wide; content translucent;

Distrib.: Stem, leaf-margin, calyx. (Fig.179)

10. PELTATE HAIR.

Foot : Not visible. Body : Multicellular, 1-celled thick, peltate disc, cells small cubical, arranged in two rings around the central cell; walls thin, periphery smooth; lumen small; content translucent.

Distrib. : Stem, leaf-surface, & corolla. (Fig. 180)

11. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, rectangular, short sized, walls thin, content translucent; head 1-celled, large, globose, wall thin, content dense granulated. Distrib.: Stem, leaf-surface, calyx & corolla. (Fig.181)

MICROMERIA BIFLORA

This species shows ten type of trichomes. (Plate 27, Fig. 182-191)

1. UNICELLULAR CONICAL HAIR.

Foot : Simple. Body : Entire, much elongated, conical; tip pointed; walls thin, rugose, straight; lumen wide; content translucent. Distrib. : Stem, leaf, calyx. (Fig. 182)

2. UNICELLULAR CURVED HAIR.

Foot: Simple. Body: 1-celled, curved, cell broad at the base; tip pointed; walls thin, rugose; lumen wide; content translucent. Distrib. : Stem, leaf & Corolla. (Fig. 183)

3. UNICELLULAR HOOKED HAIR.

Foot : Simple. Body : Entire, elongated, hooked; cell much elongated, apical part bend; tip pointed; wall thin, rugose, straight and turn aside; lumen wide; content translucent. Distrib. : Stem, corolla. (Fig. 184)

4. UNICELLULAR DENTATE HAIR.

Foot: Simple. Body: 1-celled, entire, dentate; cell

broad at base; tip pointed; walls thick, rugose, straight; lumen wide; content translucent. Distrib.: Leaf. (Fig.185)

5. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: Entire, elongated, conical; upper cell much elongated; tip pointed; lateral walls thin, rugose, straight; cross walls thin; lumen wide; content translucent. Distrib. Stem, leaf, calyx & corolla. (fig.186).

6. BICELLULAR CURVED HAIR.

Foot: Simple. Body: Entire, elongated, curved; cells much longer than breadth, slightly curved, joints swollen; tip pointed; lateral walls thin, rugose; cross walls thin; lumen wide; content translucent. Distrib. Stem, leaf, calyx & corolla. (fig.187).

7. UNISERiate CONICAL HAIR.

Foot: Simple. Body: 4-7 celled, entire, long, conical, cells long, base broad and tapering to a pointed tip; lateral & cross walls thin, rugose, straight; lumen wide; content translucent. Distrib. : Stem, leaf-margin, calyx & corolla. (Fig.188)

8. UNISERiate HOOKED HAIR.

Foot: Simple. Body : 3-4 celled, elongated, hooked;

cells longer than breadth, basal cell curved, rest straight; tip pointed; lateral walls thin; cross walls thin; lumen wide; content translucent; Distrib.: Stem, leaf-lower surface & margin, calyx. (Fig.189)

9. UNISERiate ACERATE HAIR.

Foot: Simple. Body: 3-5 celled, entire, elongated, acerate; cells narrowly elongated; tip pointed; lateral walls thin, rugose, straight; cross walls thin; lumen narrow; content opaque. Distrib. : Calyx. (Fig.190)

10. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, rectangular, hyaline, walls thin, content translucent; head 1-celled, prominently large, wall thin, content opaque. Distrib.: Stem, leaf-surface, calyx. (Fig.191)

MICROMERIA CAPITELLATA

This plant shows ten type of trichomes. (Plate 27, Fig. 192-201)

1. UNICELLULAR PAPILLOSE HAIR.

Foot : Simple. Body : Entire, long, papillose; cell much longer than breadth; tip obtuse; walls thin, rugose, straight; lumen wide; content translucent. Distrib. : Corolla. (Fig. 192)

2. UNICELLULAR HOOKED HAIR.

Foot : Compound. Body : Entire, arrect, hooked base wide; tip pointed; wall thick, rugose, turn aside; lumen wide; content opaque. Distrib. : Leaf-lower surface & margin. (Fig. 193)

3. BICELLULAR CONICAL HAIR.

Foot: Compound. Body: 2-celled, elongated, conical; cells wide & longer than breadth, upper cell tapering; tip pointed; lateral walls thick, rugose, straight; cross wall thick; lumen wide; content opaque. Distrib. Stem, leaf, infl. axis, calyx & corolla. (fig. 194).

4. BICELLULAR HOOKED HAIR.

Foot: Simple. Body: 2-celled, hooked; cells longer than breadth, upper cell at right angle to the basal erect cell; tip pointed; lateral walls thick, rugose; cross walls thin; lumen wide; content translucent.

Distrib. Leaf-upper surface & margin. (fig.195).

5. UNISERiate CONICAL HAIR.

Foot: Simple. Body: 3-8 celled, entire, conical; lower cell slightly longer than breadth, terminal cell narrow, elongated; pointed tip; lateral walls thin, rugose, constricted at joints; cross walls thin; lumen narrow; content opaque. Distrib. : Stem, leaf-surface, infl. axis, calyx. (Fig.196)

6. UNISERiate CURVED HAIR.

Foot: Simple. Body : 3-8 celled, elongated, curved; cells longer than breadth, upper cell narrow; tip pointed; lateral walls thin, rugose, convex, constricted at joints; cross walls thin; lumen wide; content translucent; Distrib.: Leaf. (Fig.197)

7. UNISERiate ACUMINATE HAIR.

Foot: Simple. Body: 3-4 celled, elongated, acuminate; lower cell wide and longer than breadth, terminal cell acuminate; tip pointed; lateral walls thick, rugose, convex or straight; cross walls thin; lumen wide; content translucent. Distrib. : Stem. (Fig.198)

8. PELTATE HAIR.

Foot : Not visible. Body : Shield like, circular in

Explanation of the figures of Plate 27.

Trichomes from Various Plant parts.

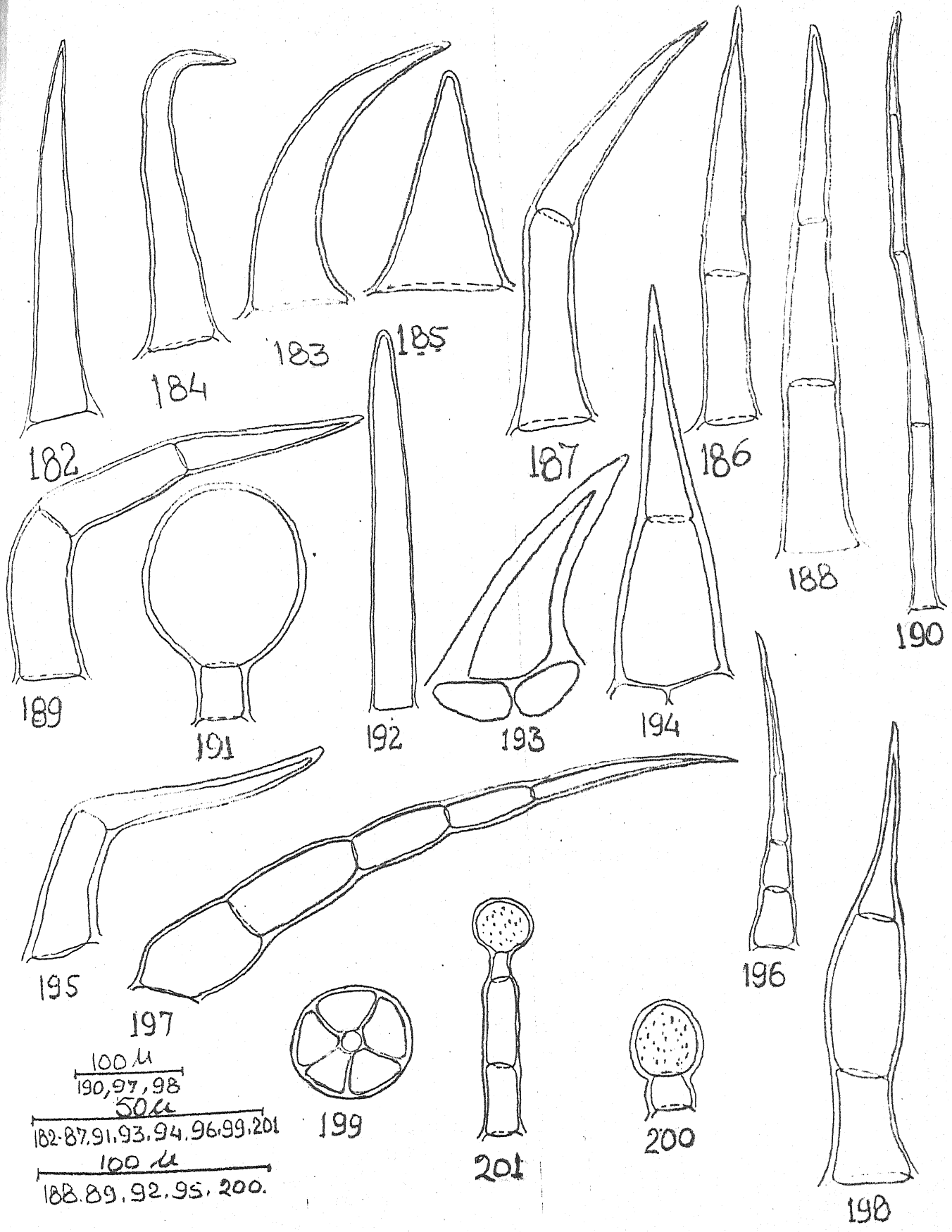
Figs. 182 - 191: Micromeria biflora

Figs. 182, 183, 184,	:	Stem.
186, 187, 188, 191	:	
Fig. 185	:	Leaf lower.
Fig. 190	:	Calyx.

Figs. 192 - 201: Micromeria capitellata.

Fig. 192	:	Corolla.
Figs. 193, 195	:	leaf margin.
Figs. 194, 196, 197, 200	:	Leaf upper.
Figs. 198, 199	:	Stem.
Fig. 201	:	Calyx.

PLATE-27



shape, parallel to the epidermis, 1-celled in thick, 5-7 celled in diameter, radiating from center, hollow center, outer walls thick, prominent and smooth; lateral walls thin, hyaline; content dense. Distrib.: Stem, leaf-surface, & calyx. (Fig. 199)

9. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, dome shaped, smaller than head, walls thin, content translucent; head 1-celled, large, globose, wall thin, content dense. Distrib.: Stem, leaf & calyx. (Fig. 200)

10. UNISERIATE GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 2-3 celled, cells longer than width, except terminal cell, lateral wall thin, smooth, straight, cross wall thin, content translucent; head 1-celled, globose, wall thin, content dense granulated. Distrib.: Stem, infl. axis & calyx. (Fig. 201)

CALAMINTHA UMBROSA

Species shows ten type of trichomes. (Plate. 28 Fig. 202-211)

1. UNICELLULAR PAPILLOSE HAIR.

Foot: Simple. Body: 1-celled, entire, oblong, papillose; cell longer than breadth; tip pointed; wall thin, smooth, convex; lumen wide; content translucent. Distrib.: Leaf-margin, bract, calyx & corolla. (Fig. 202)

2. BICELLULAR CONICAL HAIR.

Foot: Simple Body: 2-celled, entire, elongated, conical, cells much longer than breadth & of equal size; tip pointed; lateral walls thin, rugose, straight; cross walls thin; lumen wide; content translucent. Distrib.: Leaf, bract & calyx. (Fig. 203).

3. BICELLULAR HOOKED HAIR.

Foot: Simple Body: 2-celled, entire, hooked; cells longer than breadth, curved aside; tip pointed; lateral walls thick, rugose, cross walls thin; lumen wide; content translucent. Distrib.: Leaf, bract & corolla. (Fig. 204).

4. BICELLULAR BELEMNOID HAIR.

Foot: Simple Body: 2-celled, differentiated; belemnoid, basal cell wide, oblong and upper cell

sharply narrow & acuminate; tip pointed; lateral walls thick, smooth; cross walls thick; lumen wide except in upper cell; content translucent. Distrib.: Calyx & corolla. (Fig.205)

5. UNISERiate CYLINDRICAL HAIR.

Foot: Compound. Body: 3-5 celled, entire, cylindrical; cells of varied length, tip obtuse; lateral walls thin, smooth; cross walls thin; lumen wide; content translucent. Distrib. : Bract, calyx and corolla. (Fig.206)

6. UNISERiate HOOKED HAIR.

Foot: Compound. Body: 3-8 celled, entire, elongated, hooked; median cells longer than breadth, basal rectangular & right, terminal cell stiff & narrow; tip pointed; lateral walls thin, smooth; cross walls thin; lumen narrow; content translucent. Distrib. : Stem, petiole, leaf, bract, calyx & corolla. (Fig.207)

7. PELTATE HAIR.

Foot: Not visible. Body : Multicellular, 1-celled thick, Peltate disc; cells shape & size varied, walls thin; lumen wide; content opaque. Distrib.: Leaf surface. (Fig.208)

8. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, rectangular, much smaller than head, thin walled; content translucent; head 1-celled, very large, globose, wall thin; content granulated. Distrib.: Stem, leaf, bract, & corolla. (Fig.209)

9. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 2-celled, lower cell wide, much longer than breadth, upper cell short, rectangular, thin walled; content translucent; head 1-celled, oval, wall thin; content granulated light yellow. Distrib.: Stem, petiole, leaf-margin, infl. axis, bract, & corolla. (Fig.210)

10. TRICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 3-celled, lower 2 cells long & hyaline than upper, small, granulated one; head 1-celled, oval, wall thin; content opaque. Distrib.: Stem, petiole, leaf, infl. axis, bract, & calyx. (Fig.211)

MERIANDRA BENGALENSIS

Species shows six type of trichomes. (Plate.28
Fig.212-217)

1. UNICELLULAR PAPILLOSE HAIR.

Foot: Simple. Body: 1-celled, entire, long, papillose, clavate; tip rounded; wall thin, smooth, convex; lumen wide; content translucent. Distrib.: Corolla. (Fig. 212)

2. BICELLULAR CONICAL HAIR.

Foot: Simple Body: 2-celled, conical, basal cell short, rectangular, upper cell much longer than breadth, distinct; tip pointed; lateral walls thin, smooth; cross walls thin; lumen wide; content translucent. Distrib.: Stem, leaf lower surface. (Fig.213).

3. UNISERiate FURCATE HAIR.

Foot: Simple. Body: 3 or more celled, furcate at proximal end of cell, cells longer than breadth; lateral walls thin, smooth; cross walls thin; lumen wide; content opaque. Distrib. : Stem, petiole, leaf, infl. axis and calyx. (Fig.214)

Explanation of the figures of Plate 28.

Trichomes from Various Plant parts.

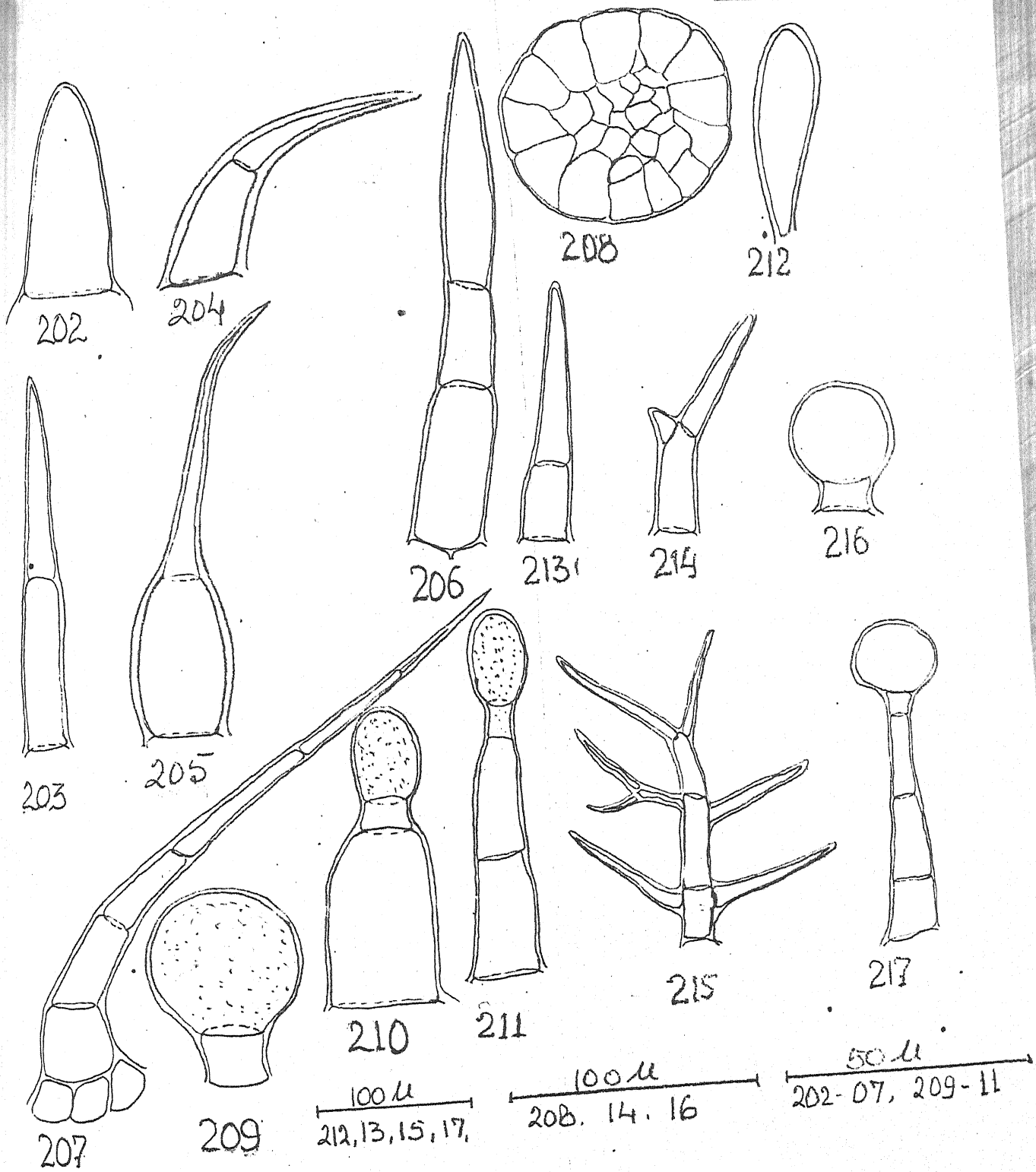
Figs. 202 - 211 : Calamintha umbrosa.

Figs. 202, 203, 204	:	leaf margin.
Fig. 205	:	Calyx.
Fig. 206	:	bract.
Figs. 207, 209, 210, 211	:	Stem.
Fig. 208	:	Leaf lower.

Figs. 212 - 217: Meriandra bengalensis.

Fig. 212	:	Corolla.
Fig. 213	:	Leaf upper.
Figs. 214, 216	:	Stem.
Fig. 215	:	Petiole.
Fig. 217	:	Calyx.

PLATE-28



4. DENDROID HAIR.

Foot: Simple. Body: Multicellular, uniseriate, multibranded dendroid; cells narrow & long, tip pointed or obtuse; lateral walls thin, smooth; cross walls thin; lumen narrow or wide; content opaque. Distrib. : Stem, petiole, leaf, infl. axis & calyx. (Fig.215)

5. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, smaller than head, rectangular; thin walled; content translucent; head 1-celled, prominently globose, wall thin; content opaque. Distrib.: Stem, petiole, leaf, infl. axis. (Fig.216)

6. UNISERiate GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 3-6 celled, cells of varied length, lateral walls thin, smooth, straight, cross walls thin; content translucent; head 1-celled, globose, content opaque (light yellow). Distrib.: Calyx. (Fig.217)

SALVIA COCCINIA

Species shows nine type of trichomes. (Plate.29 Fig.218-228)

1. UNICELLULAR PAPILLOSE HAIR.

Foot: Simple. Body: Entire, elongated, hyaline, papillose; cell wide, much longer than breadth; tip rounded; wall thin, smooth; lumen very wide; content translucent. Distrib: Stamen.

2. UNICELLULAR CONICAL HAIR. :

Foot: Simple. Body: Entire, conical; cell longer than width, base wide or normal; tip pointed; walls thin, rugose, straight; lumen narrow (Fig.219) or wide (Fig.220); content opaque. Distrib: Fig.219 - Calyx; Fig.220- Petiole leaf-margin & calyx.

3. BICELLULAR HOOKED HAIR. :

Foot: Simple. Body: Entire, hooked; lower cell erect & wide, upper cell bent to one side, narrow; tip pointed; lateral walls thick, rugose, straight and swollen at joint; cross wall thin; lumen wide; content opaque. Distrib.: Petiole, leaf & Calyx (Fig.221).

4. UNISERiate FILIFORM HAIR. :

Foot: Compound. Body: 3-8 celled, entire, elongated,

filiform; cells longer than breadth, cells of varied length, lower cells wider; tip Pointed; lateral walls thin, rugose, concave, swollen at joints; cross walls thin; lumen wide; content opaque. Distrib.: Stem, petiole, leaf, Calyx & corolla (Fig.222).

5. UNISERiate CONICAL HAIR. :

Foot: Compound. Body: 4-8 celled, entire, conical; cells longer than breadth and articulated (Fig.223) or basal cell bulbous, rest normal, cells gradually tapering (Fig. 224); tip pointed, lateral walls thick, rugose, concave or normal, joints swollen with deposition or constricted at joint; cross wall thick; lumen narrow or wide; content opaque. Distrib.: Fig.223 -Stem; Fig. 224 leaf surface & calyx.

6. UNISERiate CURVED HAIR..

Foot: Simple. Body: 3-6 celled, curved: cells oval, terminal cell elongated; tip pointed; lateral and cross walls thin, rugose, convex, constricted at joints; lumen wide; content opaque. Distrib.: Stem, petiole, leaf, calyx & corolla. (Fig.225)

7. UNISERiate HOOKED HAIR.

Foot: Compound. Body: 4-6 celled, elongated, hooked;

cells longer than breadth, base broad; tip pointed; lateral wall thick, rugose, swollen at joints; cross walls thin; lumen wide; content granulated opaque. Distrib: Stem, petiole, leaf & calyx (Fig.226)

8. UNICELLULAR GLANDULAR CAPITATE HAIR..

Foot: Simple. Body: Differentiated; stalk 1-celled, small, rectangular, wall thin, content, translucent; head 1-celled, globose, thin walled, content granulated dense. Distrib.: stem, petiole, leaf-surface, calyx & corolla (Fig 227)

9. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated: stalk 2-celled, erect, lower cell more elongated than upper, short sized, walls thin, lumen wide, content translucent except in upper cell; head 1-celled, oval, capitate, wall thick, content opaque. Distrib.: Stem, petiole, leaf, calyx & corolla Fig.228.

SALVIA HIAN

The species shows nine type of trichomes. (Plate 29 Fig.229-238).

1. UNICELLULAR PAPILLOSE HAIR.

Foot: Simple. Body: 1-celled, hyaline, papillose; base broad; tip obtuse: walls thin, rugose; lumen wide; content translucent. Distrib: Leaf-margin & calyx (Fig.229)

2. BICELLULAR CONICAL HAIR.:

Foot: Simple. Body: 2-celled, dwarf, entire, conical upper cell longer than basal; tip pointed; lateral walls thin, rugose, convex, constricted at joint; cross wall thin; lumen wide; content translucent. Distrib.: Leaf-upper surface & margin & calyx. (Fig.230)

3. BICELLULAR HOOKED HAIR..

Foot: Compound. Body: 2-celled, stiff, hooked; lower cell arrect, upper cell conical: tip pointed; lateral walls thin, rugose, straight; cross wall thin; lumen wide; content opaque. Distrib.: Leaf margin. (Fig.231)

4. UNISERiate CONICAL HAIR..

Foot: Simple. Body: 4-6 celled, entire, elongated Fig.232 or 3-celled dwarf Fig.233, of varied length, basal cell usual or dome shaped; tip pointed; lateral

& cross walls thin, rugose, swollen or constricted at Joints; lumen wide; content translucent. Distrib.: Fig.232 calyx corolla & stamen; Fig.233- stem petiole & leaf.

5. UNISERiate CURVED HAIR..

Foot: Simple. Body: 3-6 celled, elongated, curved; cells wide, rectangular; apical cell narrowly pointed; lateral walls thin, rugose, convex, constricted at joints; cross walls thin; lumen wide; content translucent. Distrib.: Stem & leaf (Fig.234)

6. UNISERiate HOOKED HAIR..

Foot: Simple. Body: 3-4 celled, entire, hooked, cells of varied shape and length; basal cell erect; tip pointed; lateral walls thick, rugose & straight; cross walls thin; lumen wide; content opaque. Distrib.: Leaf-margin. (Fig.235)

7. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, collared, hyaline, wall thin, content translucent; head 1-celled, large, globose, wall thin, content light yellow. Distrib.: Stem, petiole, leaf. (Fig.236)

8. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 2-celled, long, basal cell broad and oblong, upper cell short, wall thin, content translucent; head bicellular, globular, distinct; cell arranged length wise, wall thin and smooth, content granulated. Distrib.: Stem, calyx. (Fig.237)

9. UNISERIATE GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 4-5 celled, filiform, cells of varied length, walls thin, smooth, straight, content translucent; head 1-celled, comparatively small, rounded, wall thin, content golden yellow. Distrib.: Calyx, corolla & stamen. (Fig.238)

SALVIA PLEBEIA

This species shows ten type of trichomes (Plate 29 Fig. 239-248)

1. UNICELLULAR CONICAL HAIR.

Foot: Simple. Body: Entire, conical; tip pointed;

wall thick, smooth, straight; lumen wide; content translucent. Distrib.: Leaf-margin & calyx. (Fig. 239)

2. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: Entire, dwarf, conical; basal cell rectangular, upper cell more elongated, tapering to a pointed tip; lateral walls thick, smooth, straight; cross walls thick, revealing prominent joint; lumen wide; content opaque. Distrib.: Petiole, leaf, calyx & corolla. (Fig. 240)

3. BICELLULAR HOOKED HAIR.

Foot: Compound. Body: 2-celled, hooked, cells longer than breadth, cells of equal size, upper cell tapering to a pointed tip, lateral walls thick, smooth straight, turn aside; cross wall thin; lumen wide; content translucent. Distrib.: Stem, leaf, bract & calyx. (fig. 241)

4. UNISERIATE CONICAL HAIR.

Foot: Compound. Body: 3-4 celled, entire, elongated, conical, cells longer than breadth, Joint distinct;

tip pointed, lateral walls thick, rugose, straight;
cross walls thick; lumen narrow; content dense.
Distrib.: Stem, petiole & leaf (Fig. 242)

5. UNISERiate CURVED HAIR.

Foot: Compound. Body: 3-4 celled, long, curved, cells cubical, except the terminal acuminate one; tip pointed; lateral & cross walls thick, rugose, convex, joint distinct & constricted; lumen wide; content opaque. Distrib.: stem, petiole, leaf- surface. (Fig.243)

6. UNISERiate HOOKED HAIR.

Foot: Compound. body 3-4 celled, entire, elongated, hooked cells of varied length, upper cell longest; tip pointed; lateral & cross walls thin, rugose; lumen wide, content opaque. Distrib.: Stem, petiole, leaf, bract, calyx & corolla. (Fig.244)

7. UNISERiate ACUMINATE HAIR.

Foot: Simple. Body: 3-8 celled, entire, elongated, belemnoid, acuminate basal cell broad, oblong, remaining cells tapering to a pointed tip; lateral & cross walls thin, rugose; lumen wide; content opaque.

Explanation of the figures of Plate 29.

Trichomes from Various Plant parts.

Figs. 218 - 228: *Salvia coccinia*.

Fig. 218	:	Staminal filament
Figs. 219	:	Calyx.
Figs. 220, 221, 228	:	Petiole.
Figs. 222, 223, 225,	:	Stem.
226, 227	:	
Fig. 224	:	Leaf lower.

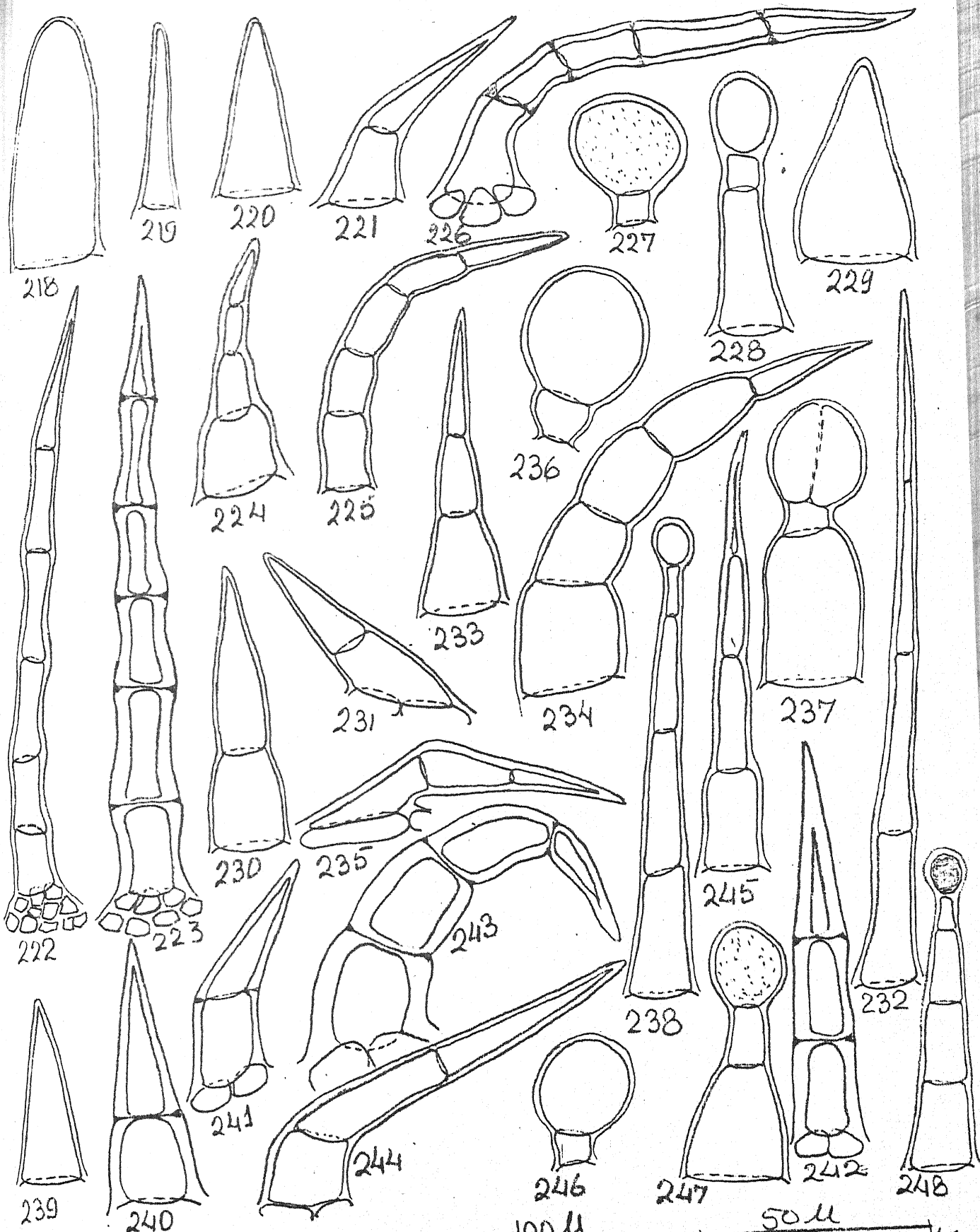
Figs. 229 - 238: *Salvia hians*.

Figs. 229, 231, 235	:	leaf margin.
Figs. 230, 232, 238	:	Calyx.
Fig. 233	:	leaf lower.
Figs. 234, 236, 237	:	Stem.

Figs. 239-248 : *Salvia plebeia*.

Fig. 239	:	Calyx.
Fig. 240	:	Petiole.
Fig. 241, 242, 243,	:	Stem.
244, 246, 247	:	
Fig. 245	:	leaf lower.
Fig. 248	:	bract.

PLATE-29



100 μ
223, 32-35, 38

150 μ
222, 24, 25, 31, 42, 44, 45

25 μ
220, 28, 47

100 μ
221, 26, 39-41, 43, 48

50 μ
218, 19, 27, 29, 30, 36, 37, 46

Distrib.: Leaf-surface, bract & calyx. (Fig. 245).

8. UNICELLULAR GLANDULAR CAPITATE :

Foot: Simple. Body: Differentiated; stalk 1-celled, hyaline, rectangular, small, wall thin, content translucent; head 1-celled, large, capitate, globose, wall thin, content opaque. Distrib.: Stem, petiole, leaf, bract & calyx. (Fig. 246)

9. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 2-celled, cells of varied length, lower cell large, dome shaped, upper cell rectangular, small, wall thin & rugose, content translucent; head 1-celled globose, distinct, wall thin, content granulated light yellow. Distrib.: Stem, petiole, leaf surface, bract & calyx. (Fig. 247).

10. UNISERIATE GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 2-celled, cells small and of varied length, wall thin & rugose, content opaque; head 1-celled globose, wall thin, content golden yellow. Distrib.: Leaf-surface, bract & calyx. (Fig. 248).

NEPETA CONNATA

This species shows nine type of trichomes (Plate 30 Fig. 249-257)

1. UNICELLULAR HOOKED HAIR.

Foot: Simple. Body: 1-celled, elongated, ancholar; cell tapering and distal end turn into hooked; tip pointed; walls thick, smooth; lumen wide; content translucent. Distrib.: Leaf upper surface. (Fig. 249).

2. UNICELLULAR ARRECT HAIR.

Foot: Simple. Body: 1-celled, entire, arrect, conical; cell longer than breadth, base broad, cell tapering to a obtuse apex; wall thin, smooth; lumen wide; content opaque. Distrib.: Stem, leaf lower surface & margin, bract & calyx. (Fig. 250).

3. BICELLULAR CONICAL HAIR.

Foot: simple Body: 2- celled, entire, elongated, conical; basal cell broad, oblong, upper cell gradually narrowed to a obtuse tip; lateral walls thick, smooth; cross wall thin; lumen wide; content translucent. Distrib.: Bract & calyx (Fig. 251)

4. BICELLULAR HOOKED HAIR.

Foot: Simple. Body: 2- celled hooked ; basal cell comparatively small & curved, upper cell long and tapering to a pointed tip; lateral walls thick, smooth; cross walls thick; lumen wide; content translucent Distrib.: stem, leaf, bract, calyx & corolla. (Fig.252)

5. UNISERiate SEPTATE FLAGELLATE HAIR.

Foot: Compound. Body: 3-7 celled, elongated, flagellate; cells of varied length, basal cell much elongated than other, terminal cell tapering to a pointed tip; lateral walls thin smooth, flexuous; cross walls thick; lumen narrow; content opaque. Distrib.: Bract & calyx. (Fig.253)

6. UNISERiate CYLINDRICAL HAIR.

Foot: Compound. Body: 3-4 celled, entire, erect, cylindrical; cells longer than breadth, tapering to a obtuse tip; lateral wall thin smooth, straight, swollen at joints; cross walls thin, lumen wide; content translucent. Distrib.: Leaf-lower surface.

(Fig. 254).

7. UNISERiate HOOKED HAIR.

Foot: Compound. Body 3-celled, hooked; cells of varied length, basal cell comparatively small, wide, erect, remaining bend aside; tip pointed; lateral walls thick, smooth constricted at Joint; cross walls thick, lumen wide; content translucent. Distrib.: Stem, leaf-surface. (Fig. 255).

8. PELTATE HAIR.

Foot: Not visible, Body: shield like, circular, parallel to epidermis, 1-celled in thickness, 10 to many celled in diameter; cells radiating from hollow center; outer walls thick, smooth; lateral walls thin hyaline; content opaque. Distrib.: Stamen. (anther). (Fig 256)

9. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, short, cell much broader, wall thin, convex, smooth, content translucent; head 1-celled, very large, oval, wall thin, lumen wide, content dense. Distrib.: Stem, leaf, calyx & corolla (Fig. 257).

NEPETA HINDOSTANA

This species shows six type of trichomes. (Plate 30 Fig. 258-266)

1. UNICELLULAR ARRECT HAIR.

Foot: Simple. Body: 1-celled, entire, arrect, conical; cell longer than breadth; tip pointed; lateral wall thin, rugose, straight, one face convex; lumen wide; content translucent. Distrib.: Bract, calyx & corolla (Fig. 258).

2. BICELLULAR ASEPTATE FLAGELLATE HAIR.

Foot: Simple. Body: 2-celled, differentiated, flagellate; basal cell wide & dome shaped, upper cell much elongated, narrow and flexuous; tip obtuse; lateral walls thin; rugose; cross walls thin; lumen wide; content opaque. Distrib.: Leaf-surface, bract calyx & corolla. (Fig. 259)

3. BICELLULAR CYLINDRICAL HAIR.

Foot : Simple. Body: Entire, elongated, cylindrical, cells broad and very long; tip obtuse; lateral walls thin, rugose, straight; cross wall thin; lumen wide; content translucent. Distrib.: Corolla. (Fig. 260)

Explanation of the figures of Plate 30.

Trichomes from Various Plant parts.

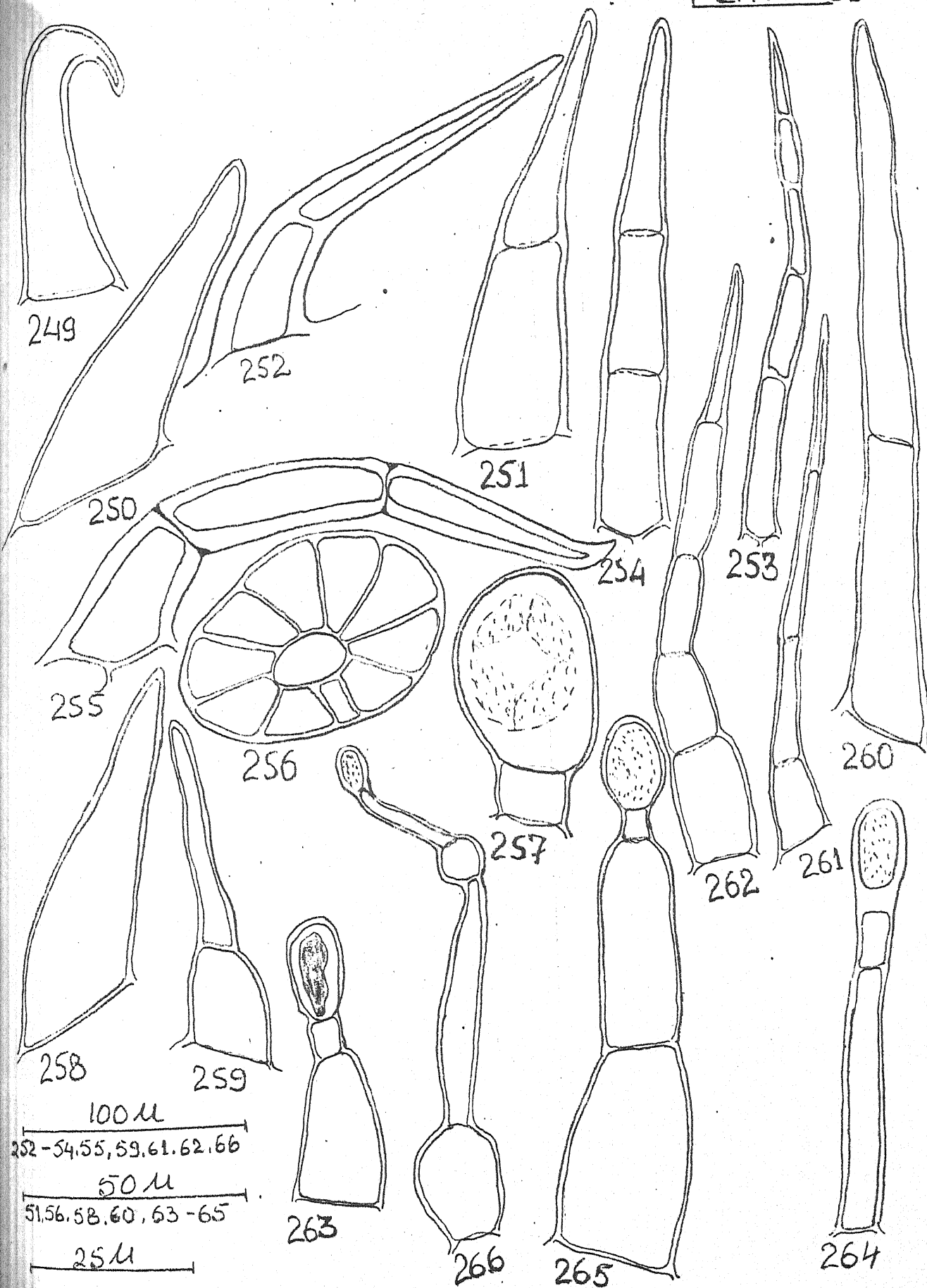
Figs. 249 - 257 : Nepeta connata.

Figs. 249, 253	:	leaf lower.
Figs. 250, 252,	:	Stem.
255, 257		
Fig. 251	:	Calyx.
Fig. 254	:	bract.
Fig. 256	:	anther.

Figs. 258 - 266 : Nepeta hindostana.

Figs. 258, 259, 261, 263	:	Calyx.
Fig. 260	:	Corolla.
Figs. 262, 263	:	bract.
Figs. 264, 265	:	Stem.

PLATE-30



4. UNISERiate FILIFORM HAIR.

Foot: Simple. Body: 3-8 celled, entire, long, filiform; cells longer than broad, narrow except the lower bulbous cell (Fig. 261) or cells wide & oval shaped (Fig. 262); tip pointed or obtuse; lateral walls thin, rugose, straight or curved; cross walls thin; lumen wide or narrow; content translucent. Distrib.: Fig. 261 - Stem, petiole, leaf, Infl. axis, bract, calyx & corolla; Fig. 262 - Bract.

5. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 2-celled cells of varied length, lower cell longer & wider than upper rectangular cells (Fig. 263) or wide, tubular (Fig. 264) walls thin & smooth, content translucent; head 1-celled, oblong, capitate, thin walled, content dark golden. Distrib.: (Fig. 263) - Leaf upper surface, bract, calyx. Corolla; (Fig. 264). Stem, infl. axis, bract.

6. UNISERiate GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 3-4 celled, uniseriate, cells of varied shape, cells broad and

long or irregularly narrowed, upper most cell rectangular Fig. 265 or narrow tubular Fig. 266. lateral walls thin and smooth, cross walls thin, lumen varied, head 1-celled, ovular, content translucent in stalk cells & granulated dense in head. Distrib.: Fig. 265 - Stem, leaf-margin, infl. axis, bract & corolla; Fig. 266. Bract.

NEPETA TIBTICA

This species shows eight type of trichomes. (plate 31 fig. 267-274)

1. UNICELLULAR FLAGELLATE HAIR.

Foot: Simple. Body: Entire, very much elongated, flagellate ; apex pointed ; walls thin, rugose; lumen narrow; content translucent. Distrib.: Calyx. (fig. 267)

2. BICELLULAR ASEPTATE FLAGELLATE HAIR.

Foot: Simple. Body: 2-celled, Differentiated; lower cell-1 celled, short sized, erect, cylindrical; upper cell much elongated, narrow, flexuous, hyaline; tip obtuse; lateral wall thin; smooth; cross wall thin;

lumen narrow; content translucent. Distrib: calyx.
(fig. 268)

3. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: 2-celled, entire, conical; cells of varied length, lower cell small, dome shaped, upper cell long & tapering to a pointed tip; lateral wall thin & smooth; cross wall thin, lumen wide; content translucent. Distrib.: Stem & bract. (fig-269)

4. UNISERiate FILIFORM HAIR.

Foot: Simple. Body: 3-8 celled, entire, erect, filiform; cells of varied length, basal cell short with bulbous base: tip pointed; lateral & cross walls thin, rugose. Straight, lumen narrow; content translucent. Distrib: Bract, calyx & corolla. (Fig. 270)

5. UNISERiate HOOKED HAIR

Foot: Simple. Body: 3-4 celled, hooked; cells long, wide; tip obtuse; lateral walls thick, smooth; cross walls thin; lumen wide: content translucent. Distrib.: Calyx. (Fig. 271)

6. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, short, clavate, broader towards the apex. Wall thin & smooth, content opaque; head 2-celled, distinct, large, oblong, cells arrange length wise, walls thin content dense. Distrib: stem & leaf lower surface. (Fig. 272)

7. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 2- celled, lower cell very long, filiform upper cell short, cubical, walls thin, smooth & straight, lumen narrow, content translucent except in collar in which content dense, head 1-celled, rounded. Capitate, wall thin content dense. Distrib: Bract, Calyx& Corolla. (Fig. 273)

8. UNISERiate GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 3-4 celled, uniseriate, lower most cell long & wide, remaining cells wide, rectangular and isodimetrical, walls thin& and smooth, content translucent; head 1-celled, oval, large, capitate, wall thin, content dense,

Distrib stem. (Fig. 274)

SCUTELLARIA GROSSA

This plant shows thirteen type of trichomes:- (Plate 31. Fig. 275-288)

1. UNICELLULAR PAPILLOSE HAIR.

Foot: Simple. Body: 1-celled, entire, hyaline, papillose; cell short, with broad base (Fig. 275) or much elongated (Fig. 276); tip obtuse, walls thin, smooth; lumen wide; content translucent. Distrib.: Fig. 275- corolla; Fig. 276- corolla & stamen.

2. UNICELLULAR CONICAL HAIR.

Foot: Compound. Body: Entire, elongated, conical, cell sharply tapering to a long, narrow; pointed tip, walls thick, smooth, straight; lumen narrow; content translucent. Distrib: Bract, calyx & stamen. (Fig. 277)

3. BICELLULAR ASEPTATE FLAGELLATE HAIR.

Foot: simple. Body: 2- celled, differentiated; basal

cell erect, wide & bulbous, wall convex but upper cell very long narrow, flagellate; tip pointed; wall thin, smooth flexuous; cross wall thin; lumen narrow; content opaque. Distrib.: corolla. (Fig. 278)

4. BICELLULAR CYLINDRICAL HAIR.

Foot: Simple. Body: 2-celled, long, cylindrical: cells much longer than breath, lower cell wider & elongated than upper, tip rounded; lateral walls thin, rugose, convex; cross walls thin lumen wide; content translucent. Distrib: Stamen. (Fig. 279)

5. BICELLULAR HOOKED HAIR.

Foot: Compound. Body : 2-celled, hooked, cells longer than breath, upper cell long, attenuate, bend, tip pointed; lateral walls thick, smooth, straight, lumen narrow, content opaque. Distrib.: leaf-lower surface & margin & bract. (Fig. 280)

6. BICELLULAR ACUMINATE HAIR.

Foot: Simple. Body: Very long, acuminate; cells much longer than breath, cells of equal size, tip narrow & pointed; lateral walls thin, smooth, straight; cross walls thin; lumen narrow; content opaque. Distrib.:

Bract & calyx. (Fig. 281)

7. UNISERiate FILIFORM HAIR.

Foot: Simple. Body: 3-6 celled, entire, elongated, filiform; cells longer than breath; tip pointed; lateral wall thin, smooth, straight, cross wall thin; lumen narrow; content opaque. Distrib: Stem, leaf, Infl. axis, bract & calyx. (Fig 282)

8. UNISERiate SEPTATE FLAGELLATE HAIR.

Foot: Simple. Body: 4-6 celled, differentiated, flagellate; basal cell erect, broad & long, remaining cells narrow, elongated, flexuous; tip pointed lateral and cross walls thin, smooth, wavy; lumen narrow; content opaque. Distrib.: Calyx. (Fig. 283)

9. UNISERiate CURVED HAIR.

Foot : Compound. Body 3-4 celled. elongated, curved; cells longer than breath & narrowly elongated, base wide; tip pointed, lateral walls thick, smooth; cross wall thick, lumen narrow; content opaque. Distrib.: Leaf-lower surface & margin, infl. axis & bract. (Fig. 284)

10. UNISERiate ACERATE HAIR.

Explanation of the figures of Plate 31.

Trichomes from Various Plant parts.

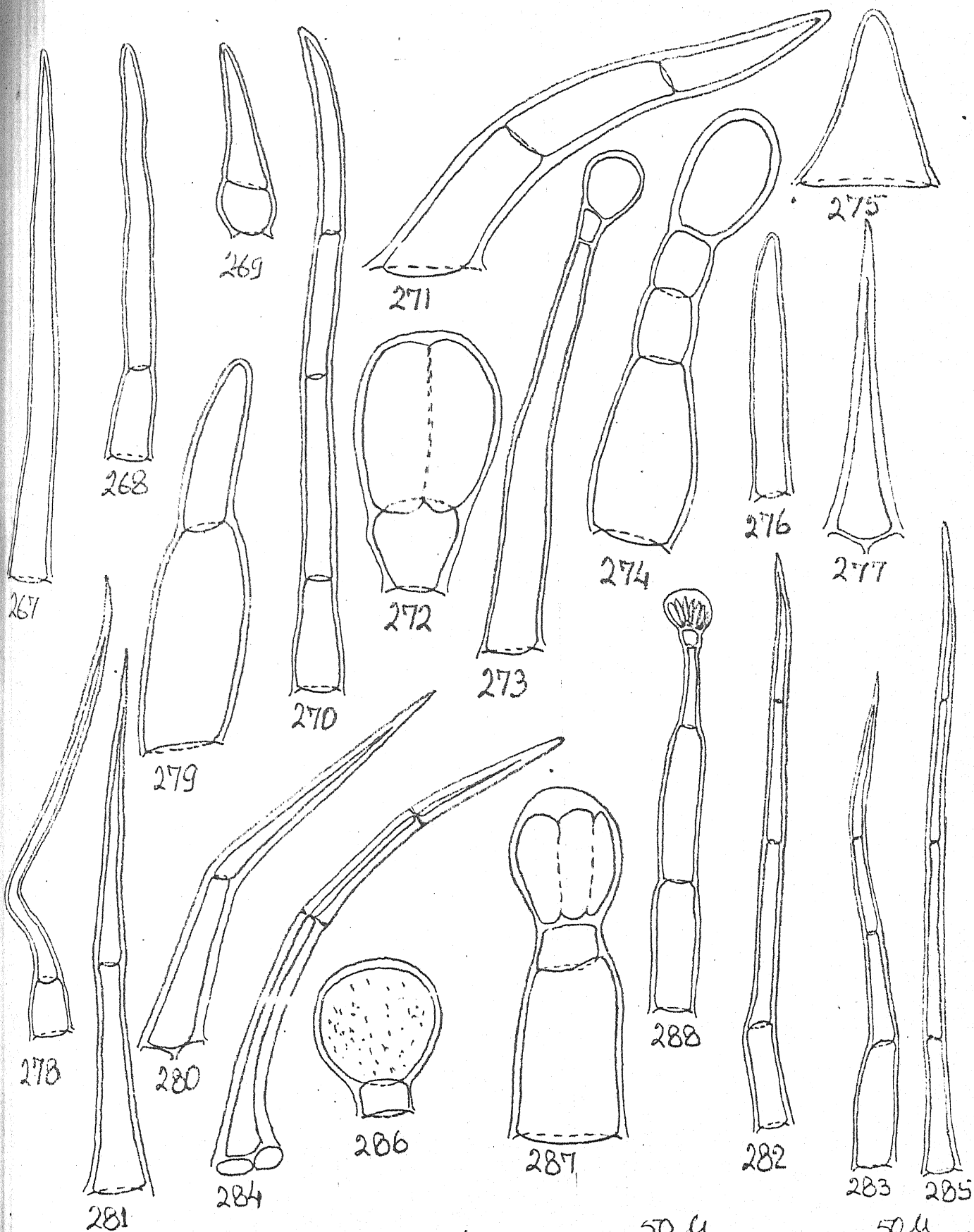
Figs. 267 - 274 : Nepeta tibetica.

Figs. 267, 268,	:	Calyx.
270, 271		
Figs. 269, 273	:	bract.
Figs. 272, 274	:	Stem.

Figs. 275 - 288 : Scutellaria grossa.

Figs. 275, 276, 278	:	Corolla.
Figs. 277, 281	:	bract.
Fig. 279	:	Staminal filament.
Figs. 280, 284	:	leaf margin.
Figs. 282, 286, 287	:	Stem.
Figs. 283, 285, 288	:	Calyx.

PLATE-31



200 μ
282 83.85

150 μ
273, 80.8, 184.88.

100 μ
270, 76.78

50 μ
272, 74.75, 77, 79.86, 87.

50 μ
261-69, 71

Foot: Simple. Body: 3-4 celled, entire, narrow, elongated, acerate; cells long; tip pointed; lateral walls thin. smooth. straight; cross walls thin; lumen narrow; content opaque. Distrib: Calyx. (Fig-285)

11. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, dwarf, rectangular, wall thin, content translucent; head 2-celled, large, globose, distinct, cells arranged length wise, wall thin & smooth ; content granulated dense. Distrib: stem, leaf surface, infl. axis.bract, calyx & corolla. (Fig-286)

12. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot: simple.Body: Differentiated; stalk 2-celled, long, cells of varied length, basal cell larger than head, upper cell smaller; head oblong, multicellular, glandular cells arrange lenghtwise, walls thin, content dense. Distrib.: Stem, corolla & stamen. (Fig-287)

13. UNISERIATE GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 4-celled,

uniseriate, basal cell cylindrical, longer than breadth, uppercell narrow, elongated, terminated into a small rectangular collar of the head, lateral walls thin, smooth, cross walls thin, content translucent; head small, multicellular, globose, cell long, radiating, wall thin content dense. Distrib. : Infl. axis, bract, calyx, corolla & stamen (Fig. 288)

BRUNELLA VULGARIS

This species shows six type of trichomes (Plate 32 Fig. 289-294)

1. UNICELLULAR FLAGELLATE HAIR.

Foot: Simple. Body: Elongated, hyaline, flagellate; cell much longer than breadth; tip obtuse, walls thin, smooth; lumen wide; content translucent. Distrib. : corolla (Fig. 289).

2. UNICELLULAR DENTATE HAIR.

Foot: Compound. Body: Entire, dentate; tip pointed; walls thick, rugose, convex one side; lumen narrow; content opaque. Distrib. : Leaf-margin, bract &

calyx. (Fig.290)

3. BICELLULAR CONICAL HAIR.

Foot: Compound. Body : Entire, conical; cells of varied length, basal cell spreaded, upper cell elongated than breadth; tip pointed; lateral walls thick, rugose; cross wall thick; lumen wide; content opaque. Distrib. : Leaf-margin, bract & calyx. (Fig.291)

4. UNISERiate CONICAL HAIR.

Foot : Compound. Body : 3-9 celled, long, conical cells of varied length, longer than breath except terminal cell, basal cell pulvinous; tip pointed; lateral walls thick, rugose, cross walls thick; lumen narrow; content opaque. Distrib: Leaf-margin, bract & calyx. (Fig.292)

5. UNISERiate HOOKED HAIR.

Foot : Compound. Body : 3-4 celled, entire, hooked; cells rectangular, basal cell arrect, broader than length; tip pointed; lateral walls thick, rugose, cross walls thick, lumen narrow; content opaque. Distrib.: Leaf-margin, bract & calyx. (Fig.293)

6. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 1-celled, shorter than head, rectangular, thin walled, content translucent; head very large, globose, wall thin, content granulated dense. Distrib. : calyx and corolla. (Fig.294)

ANISOMELES INDICA

This plant shows eight type of trichomes. (Plate, 32 Fig.295-302)

1. UNICELLULAR PAPILLOSE HAIR.

Foot: Simple. Body: 1- celled, entire, hyaline, papillose; tip obtuse; walls thin, smooth, straight; lumen wide; content translucent. Distrib.: Bract, stamen. (Fig.295)

2. BICELLULAR CONICAL HAIR.

Foot: Simple. Body: 2 - celled, entire, conical; cells much elongated then breadth; tip pointed; lateral wall thin, smooth, straight, swollen at joint; cross wall thin; lumen wide; content opaque.

Distrib.: Leaf & calyx. (fig. 296)

3. BICELLULAR HOOKED HAIR.

Foot: Simple. Body: 2-celled, entire, hooked; cells longer than breadth and of varied length, upper cell bending & more elongated; tip pointed; lateral walls thin rugose, swollen at joint; cross wall thin; lumen wide; content opaque. Distrib.: Stem, leaf & calyx. (fig. 297)

4. UNISERiate FILIFORM HAIR.

Foot: Simple. Body: 4-8 celled, entire, filiform; cells longer than breadth and of equal length; tip pointed; wall thin, smooth; cross wall thin; lumen narrow; content translucent. Distrib.: Stem, petiole, calyx, corolla, stamen. (Fig. 298)

5. UNISERiate HOOKED HAIR.

Foot: Simple. Body: 3-4 celled, entire, cells incurved & elongated than breadth; tip pointed; lateral & cross wall thick, rugose, swollen at joints; lumen wide; content opaque. Distrib.: Stem, petiole, leaf & calyx. (Fig. 299)

6. UNISERiate FURCATE HAIR.

Foot: Simple. Body: Multicellular, uniseriate furcate; branch 1-celled elongated, cylindrical; cell longer than breadth; joint swollen; lateral wall thin, smooth & irregular; cross walls thin; lumen wide; content translucent. Distrib. calyx. (Fig.300)

7. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated, stalk 1-celled, small, rectangular, thin walled, content translucent; head 1-celled, large, globose, thin walled, content pale yellow. Distrib.: stem. petiole, leaf surface, calyx, corolla. (Fig.301)

8. UNISERiate GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 3-15 celled, very long, filiform, cell varied length & shape; walls thin, smooth, content translucent; head 1-celled, small, globose, wall thin; content pale yellow granulated; Distrib.: Petiole, leaf surface, calyx & corolla. (Fig.302)

LAMIUM ALBUM

This plant shows seven type of trichomes (Plate 32 Fig.303.309)

1. UNICELLULAR PAPILLOSE HAIR.

Foot : Simple. Body : 1 celled, entire, long, hyaline, papillose; cell much longer than breadth; base broad; tip obtuse, walls thin smooth; lumen wide; content translucent. Distrib. calyx. (Fig.303)

2. UNICELLULAR FLAGELLATE HAIR.

Foot : Simple. Body : 1-celled, elongated, flagellate; cells much longer than breadth; tip pointed, wall thin, smooth, flexuous; lumen narrow; content translucent. Distrib. Leaf upper surface & margin, corolla & stamen (Fig.304)

3. UNICELLULAR CONICAL HAIR.

Foot : Simple. Body : Entire, elongated, conical, cell long gradually tapering; tip pointed, walls thick, smooth, straight; lumen wide; content translucent. Distrib. Leaf calyx & corolla. (Fig.305)

Explanation of the figures of Plate 32.

Trichomes from Various Plant parts.

Figs. 289 - 294 : *Brunella vulgaris*.

Fig. 289	:	Corolla.
Figs. 290, 291,	:	bract.
292, 293	:	
Figs. 294	:	Calyx.

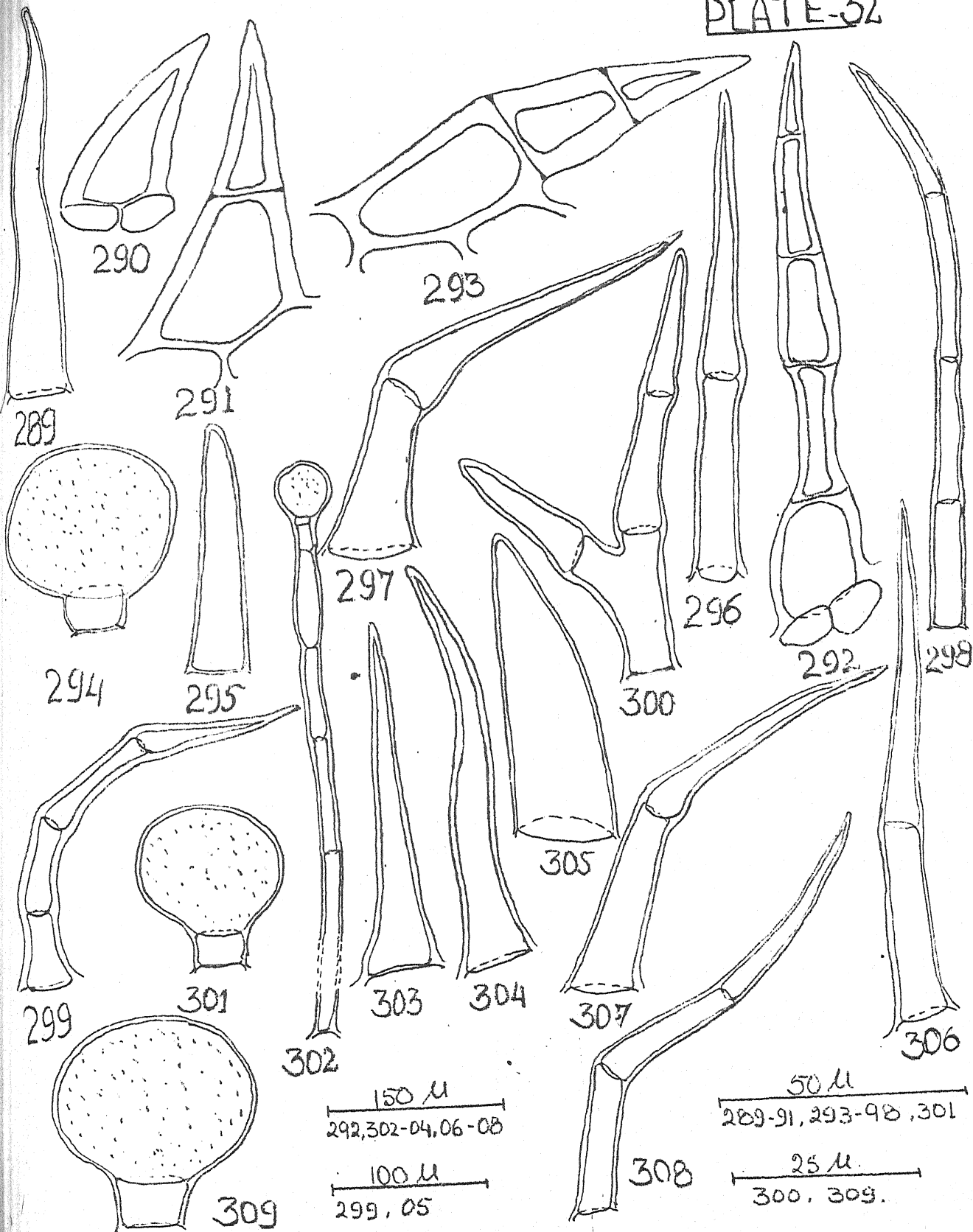
Figs. 295 - 302 : *Anisomeles indica*.

Fig. 295	:	Staminal filament.
Fig. 296	:	leaf lower.
Figs. 297, 299, 301	:	Stem.
Figs. 298, 302	:	Corolla.
Fig. 300	:	Calyx.

Figs. 303 - 309 : *Lamium album*.

Fig. 303	:	Calyx.
Fig. 304	:	leaf lower.
Figs. 305, 306	:	leaf margin.
Fig. 307	:	Stem.
Figs. 308, 309	:	Petiole.

PLATE-32



4. BICELLULAR CONICAL HAIR.

Foot : Simple. Body : 2 celled, entire, elongated, conical; cells longer than breadth; upper cell more elongated than lower; tip pointed; lateral walls thick, smooth, straight; cross wall thin; lumen wide; content translucent. Distrib.: Leaf & calyx (Fig.306)

5. BICELLULAR HOOKED HAIR.

Foot : Simple. Body : Entire, hooked; cells much elongated than breadth, upper cell uncurved; tip pointed; lateral walls thick, smooth, swollen at joint; cross wall thin; lumen wide; content translucent. Distrib.: Stem, petiole, leaf, calyx. (Fig.307)

6. UNISERIATE HOOKED HAIR.

Foot : Simple. Body : 3-4 celled, elongated, hooked; cells narrow, upper cell more elongated than remaining cells; tip pointed; lateral walls thick, smooth, straight; cross walls thin; lumen wide; content translucent. Distrib. Stem, petiole, leaf surface, calyx. (Fig.308)

7. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; Stalk 1-celled, short, rectangular, thin walled, content translucent; head 1-celled, large, globose, wall thin; content granulated opaque. Distrib: Stem, petiole, calyx & corolla. (Fig.309)

LEUCAS URTICAEFOLIA

This plant shows twelve type of trichomes (Plate 33 Fig.310-323)

1. UNICELLULAR PAPILLOSE HAIR.

Foot : Not observed. Body : 1-celled, hyaline, elongated, papillose; tip rounded, wall very thin : lumen reduced, narrow; content translucent. Distrib. Petiole, leaf, calyx. (Fig.310)

2. UNICELLULAR FLAGELLATE HAIR.

Foot : Simple. Body : Elongated, flagellate; cell much elongated than breadth, tip obtuse, wall thin, rugose, wavy; lumen narrow; content opaque. Distrib. Petiole, bract. (Fig.311)

3. UNICELLULAR ACERATE HAIR.

Foot : Compound. Body : Entire, elongated, acerate, cell much elongated than breadth, narrow; tip pointed; walls thin, rugose, straight; lumen narrow; content opaque. Distrib. Petiole, bract, calyx. (Fig.312)

4. UNICELLUAR CONICAL HAIR.

Foot : Simple. Body: Erect, conical; cell longer than breadth; cell tapering at distal end; tip obtuse; wall thin, smooth, convex; lumen wide; content translucent. Distrib.: Corolla (Fig.313).

5. UNICELLULAR ARRECT HAIR.

Foot: Not observed. Body : 1 celled, stiff, elongated, arrect, cell long, bulbous at base; pointed at tip; wall thin & smooth; lumen reduced; content translucent. Distrib: Bract & calyx. (Fig.314)

6. BICELLULAR CONICAL HAIR.

Foot : Simple. Body : Entire, elongated, conical; cells wide, longer than breadth, upper cell more

elongated and tapering; tip pointed; lateral walls thick, smooth, straight; cross walls thin; lumen wide; content translucent. Distrib. Petiole, leaf, bract. (Fig. 315)

7. BICELLULAR HOOKED HAIR.

Foot : Simple or compound. Body : Differentiated, hooked; basal cell long, erect with narrow lumen (Fig. 317) or short, rectangular with wide lumen (Fig. 316) upper cell much elongated, bending, conical; tip pointed; lateral wall thick or thin, rugose & straight; cross wall thick; lumen narrow or wide; content opaque. Distrib: Fig. 316 - Corolla. Fig. 317 - Stem, petiole, leaf, bract & calyx.

8. BICELLULAR ACUMINATE HAIR.

Foot : Simple. Body : 2-celled, narrowly elongated, acuminate; cells very long; terminal cell much elongated than breadth; tip pointed; lateral walls thin. rugose, straight. joint simple Fig.318 or articulated Fig.319; cross wall thick; lumen narrow; content translucent. Distrib : Fig.318-Stem, petiole & leaf; Fig.319 - Petiole, leaf, bract and calyx.

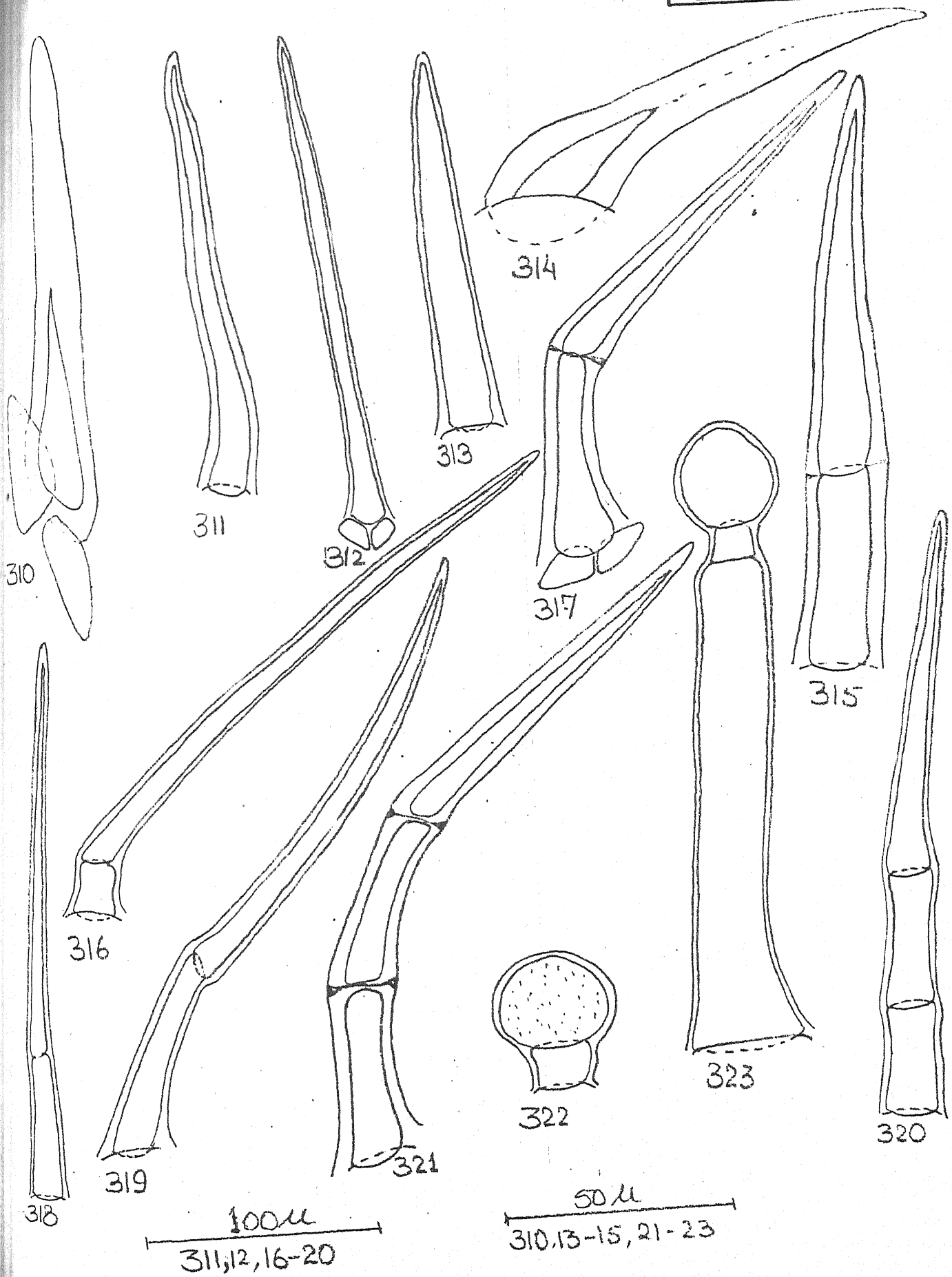
Explanation of the figures of Plate 33.

Trichomes from Various Plant parts.

Figs. 310 - 323 : Leucas urticaefolia.

Figs. 310, 314, 317	:	Bract.
Figs. 311, 315, 319, 323	:	Leaf upper.
Figs. 312, 320	:	Petiole.
Figs. 313, 316	:	Corolla.
Figs. 318, 321, 322	:	Stem.

PLATE-33



9. UNISERiate CONICAL HAIR.

Foot : Simple. Body : 3 - 4 celled, elongated, conical; cells of varied length and longer than breadth, upper cell longest & tapering; tip pointed, lateral walls thin, rugose, straight, swollen at joint; cross wall thin; lumen wide; content opaque. Distrib. : Petiole (Fig.320)

10. UNISERiate HOOKED HAIR.

Foot : Simple. Body : 3 - 4 celled, elongated, hooked; cells of varied length, upper cell much elongated; tip pointed; lateral walls thick, rugose, curved, swollen at joints; cross walls thick; lumen narrow; content opaque. Distrib. : Stem, petiole, leaf lower surface, bract. (Fig.321)

11. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; Stalk 1-celled, short and as long as breadth, walls thin, content translucent; head 1-celled, large, capitate, globose, thin walled, content dense granulated. Distrib. : Stem, petiole, leaf, calyx and corolla. (Fig.322)

12. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; Stalk 2-celled, lower cell much elongated and wide, upper cell very small & isodiametric, wall thin & smooth, content translucent; head 1-celled, large, globose, thin walled, content dense. Distrib. : Stem, petiole, leaf. (Fig.323)

LEUCAS LANATA

This plant shows nine type of trichomes (Plate 34 Fig. 324 - 332)

1. UNICELLULAR CONICAL HAIR.

Foot : Simple. Body : Entire, elongated, erect, conical; cell much elongated than breadth, base spreaded; tip pointed; wall thick, rugose, straight; lumen narrow; content opaque. Distrib: Stem, leaf upper surface & calyx. (Fig 324)

2. BICELLULAR FILIFORM HAIR.

Foot : Simple. Body : Entire, elongated, filiform; cell of varied length, upper cell much elongated than lower; tip pointed; lateral walls thick, rugose,

swollen at joint, cross wall thin; lumen narrow;
content opaque. Distrib.: Petiole, leaf, calyx.
(Fig. 325)

3. BICELLULAR ASEPTATE FLAGELLATE HAIR.

Foot : Simple. Body : Differentiated; lower cell 1-
celled, erect, cell longer than breadth, rectangular,
upper cell very long, narrow, flexuous; tip pointed;
lateral & cross wall thin, rugose, wavy; lumen
narrow; content opaque. Distrib.: corolla. (Fig. 326)

4. BICELLULAR HOOKED HAIR.

Foot : Simple. Body : 2- celled, Differentiated;
hooked; basal cell longer than breadth, curved with
spreaded base, upper cell wide, very long, straight,
gradually tapering; tip pointed; lateral walls thick,
rugose, straight, cross wall thick; lumen wide;
content opaque. Distrib.: Stem. petiole, leaf, bract,
(Fig. 327)

5. BICELLULAR ACUMINATE HAIR.

Foot : Simple. Body : Elongated, acuminate; lower cell
short, rectangular, upper cell very long. narrow.
acuminate; tip pointed; lateral walls thin. smooth.

straight, swollen at the base; cross wall thin; lumen wide; content translucent. Distrib.: Corolla. (Fig.328)

6. UNISERiate FILIFORM HAIR.

Foot : Simple. Body : 3-5 celled, entire, elongated, filiform; cell of varied length; tip obtuse; lateral walls thick, rugose, straight, swollen at joints; cross walls thin; lumen wide; content translucent. Distrib.: Leaf-surface, corolla. (Fig.329)

7. UNISERiate CURVED HAIR.

Foot : Simple. Body : 3 celled, long, curved; cell of varied length and longer than breadth, cells narrowly elongated; tip pointed; lateral walls thick, rugose, swollen at joints, joint distinct; cross walls thick; lumen narrow; content opaque. Distrib.: Petiole, Leaf-lower surface & margin, bract & calyx. (Fig.330)

8. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated, Stalk 1 celled, shorter than head, rectangular, thin walled, content translucent; head 1-celled, very large, globular,

thin walled, content granular. Distrib.: Stem, petiole, leaf surface, bract & calyx. (Fig.331)

9. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Compound. Body : Differentiated; stalk 2-celled, erect, lower cell wide and much elongated, upper cell short, rectangular and more wider than length, wall thick & smooth, content translucent; head 1-celled, distinct, large, elliptical, wall thick, content dense. Distrib. Leaf-lower surface & calyx. (Fig.332)

LEUCAS NEPETAEFOLIA

This plant shows fourteen type of trichomes (Plate 34 & 35 Fig. 333 - 346)

1. UNICELLULAR PAPILLOSE HAIR.

Foot : Simple. Body : 1-celled, entire, papillose; cell long, tubular with emerging base; tip rounded; wall thick, smooth; lumen wide; content translucent. Distrib: Stem, leaf margin (Fig.333)

Explanation of the figures of Plate 34.

Trichomes from Various Plant parts.

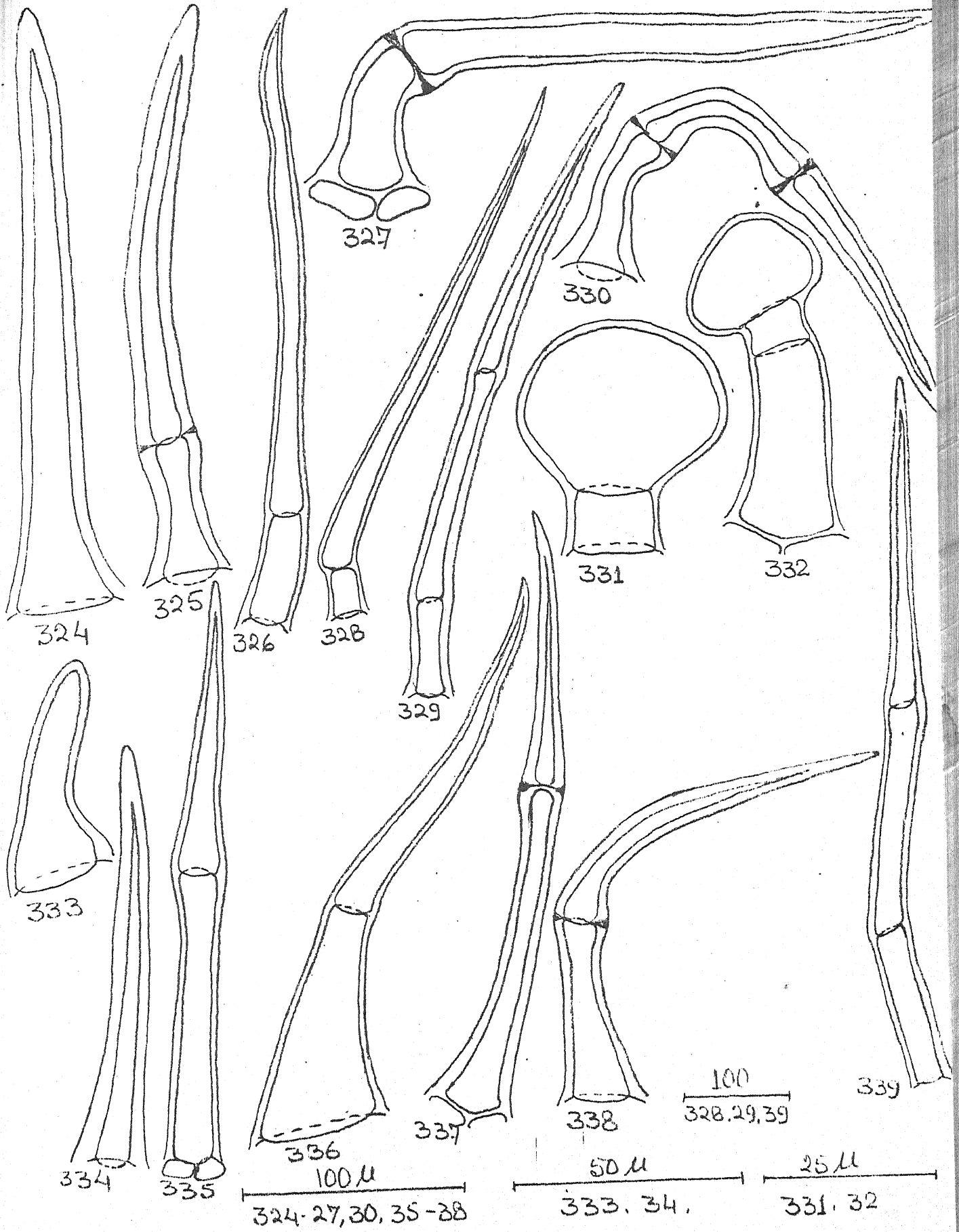
Figs. 324 - 332 : *Leucas lanata*.

Figs. 324, 326, 327, 331	:	Stem.
Figs. 325, 330	:	Petiole.
Figs. 328, 329	:	Corolla
Figs. 332	:	Leaf upper.

Figs. 333 - 339 : *L. nepetaefolia*.

Fig. 333	:	Stem.
Figs. 334, 337	:	Bract.
Figs. 335, 336	:	Calyx.
Fig. 338	:	L. lower.
Fig. 339	:	Corolla.

PLATE-34



2. UNICELLULAR CONICAL HAIR.

Foot : Simple. Body : Entire, elongated, conical; cell much longer; tip pointed; walls thick, rugose, straight; lumen narrow; content opaque. Distrib. : Bract & calyx. (Fig.334)

3. BICELLULAR FILIFORM HAIR.

Foot : Compound. Body : Entire, very long, filiform; cells much longer than breadth; tip pointed; lateral walls thin, rugose, swollen at joint; cross wall thin, lumen wide; content opaque. Distrib.: calyx, corolla. (Fig.335)

4. BICELLULAR ASEPTATE FLAGELLATE HAIR.

Foot : Simple. Body : 2- celled, Differentiated, flagellate; upper cell very long, flexuous; lower cell short, wide, erect, curved to one side; tip pointed; lateral walls thin & smooth, joint distinct; cross walls thin, lumen wide and narrow; content translucent. Distrib.: Calyx (Fig.336)

5. BICELLULAR CONICAL HAIR.

Foot : Compound. Body : Entire, elongated, conical; cells much longer than breadth; tip pointed; lateral

walls thick, rugose, straight, swollen at joint, joint distinct; cross wall thin, lumen narrow; content translucent. Distrib.: Stem, leaf, bract & calyx. (Fig.337)

6. BICELLULAR HOOKED HAIR.

Foot : Simple. Body : Entire, elongated, hooked; upper cell much elongated, curved; tip obtuse; lateral & cross walls thick, rugose, swollen at joint; lumen wide; content translucent. Distrib.: Leaf-surface & bract.

7. UNISERiate FILIFORM HAIR.

Foot : Simple. Body : 3-6 celled, entire, elongated, filiform; cell longer than breadth; tip pointed; lateral walls thin, rugose, smooth, straight, swollen at joints; cross walls thin; lumen wide; content translucent. Distrib.: Calyx & corolla. (Fig.339)

8. UNISERiate ASEPTATE FLAGELLATE HAIR.

Foot : Simple. Body: 3 celled, elongate, differentiated; cells longer than breadth, cells erect, straight except the terminal, narrow, very long, flexuous one: tip pointed; lateral wall thin,

rugose, swollen at joint; lumen wide or narrow;
content translucent. Distrib.: Stem, leaf
lower. (Fig. 340)

9. UNISERiate CURVED HAIR.

Foot : Simple. Body: 3-celled, elongated, curved;
cell of varied length, upper cell longest with upward
obtuse tip; lateral walls thick, rugose, joints
distinct and swollen; cross walls thick; lumen wide;
content opaque. Distrib. Stem. (Fig. 341)

10. UNISERiate HOOKED HAIR.

Foot: Simple. Body: 3-celled, elongated, hooked;
lower two cells comparatively short, curved, upper
cell much elongated, straight; tip pointed; lateral
walls thick, rugose, joint distinct & swollen; cross
walls thick; lumen narrow; content opaque. Distrib.:
Stem. (Fig. 342)

11. UNISERiate ACUMINATE HAIR.

Foot: Compound. Body: 3-4 celled, very long,
acuminate; cells narrow & much elongated than
breadth; tip pointed; lateral wall thick, smooth,
straight, swollen at joints; cross walls thick; lumen

very narrow; content opaque. Distrib.: Bract & calyx. (Fig. 343)

12. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, short, rectangular, thin walled, content translucent; head 1-celled, globose, capitate, thin walled, content dense granular. Distrib.: Stem, leaf surface, calyx & corolla. (Fig. 344)

13. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 2-celled erect, cells longer than breadth, lower cell much elongated, thin walled, lumen wide, content translucent; head 1-celled, large, globose, thin walled, content dense. Distrib.: Stem, calyx. (Fig. 345)

14. UNISERiate GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 3 celled, cylindrical, cell long tubular, lateral walls thin, lumen wide, content translucent; head 1-celled, large, capitate, globose, walled thin; content dense. Distrib.: Leaf. (Fig. 346)

LEUCAS MOLLISSIMA

This species shows ten type of trichomes (Plate 35 fig. 447-457)

1. UNICELLULAR CONICAL HAIR.

Foot : Simple. Body : Entire, elongated, cell long gradually tapering lumen wide (Fig. 347) or abruptly pointed; wall thick; straight; lumen narrow (Fig. 348); rugose; wall surface; content opaque. Distrib. : (Fig. 347) calyx; Fig. 348 Leaf, calyx.

2. BICELLULAR FILIFORM HAIR.

Foot : Simple. Body : 2-celled, very long, elongated, cells of varied length, upper cell very much elongated, tip pointed; lateral wall thick, rugose, straight; cross wall thin; lumen narrow; content opaque. Distrib. : leaf upper surface & margin, calyx. (Fig. 449)

3. BICELLULAR CONICAL HAIR.

Foot : Compound. Body : Entire, erect, conical; cells longer than breadth & of equal size, base spreaded; tip pointed; lateral wall thin smooth, straight; cross wall thin; lumen wide; content translucent.

Explanation of the figures of Plate 35.

Trichomes from Various Plant parts.

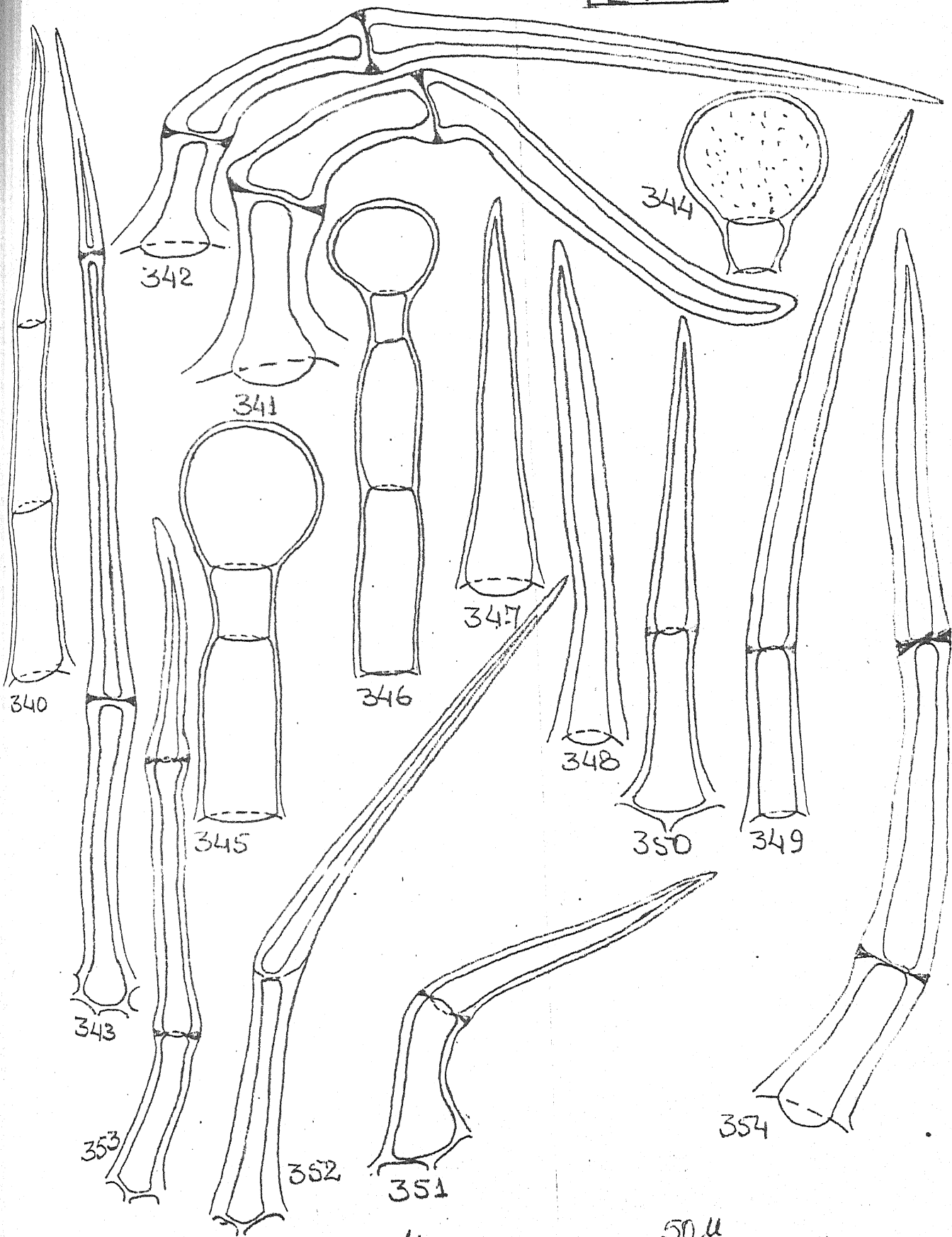
Figs. 340 - 346 : *L. nepetaefolia*.

Figs. 340, 341, 342,	:	Stem.
344, 345		
Fig. 343	:	Bract.
Figs. 346	:	Leaf lower.

Figs. 347 - 354 : *L. mollissima*.

Figs. 347, 349,	:	Calyx.
352, 353		
Figs. 348, 350	:	Leaf lower.
Fig. 351	:	Petiole.
Fig. 354	:	Stem.

PLATE-35



200 μ
342, 43

100 μ
340, 44, 46, 51, 52, 54,

50 μ
341, 45, 47-50, 53

Distrib. : Leaf & calyx. (Fig. 350)

4. BICELLULAR HOOKED HAIR.

Foot : Compound. Body : Entire, hooked; cells longer than breadth, basal cell curved, upper cell turned aside, long & straight; tip pointed; lateral walls thick, smooth; cross walls thin; lumen wide; content translucent. Distrib. : Petiole, leaf & calyx. (Fig. 351)

5. BICELLULAR ACUMINATE HAIR.

Foot : Compound. Body : Entire, elongated, acuminate; cells narrow, longer than breadth, upper cell much elongated, articulated; tip pointed; lateral walls thick, smooth, straight, swollen at joints; cross wall thick; lumen narrow; content opaque. Distrib. : Leaf upper surface and margin, calyx. (Fig. 352)

6. UNISERiate FILIFORM HAIR.

Foot : Compound. Body : 3-4 celled. entire, long, filiform; cells of varied length & longer than breadth; tip pointed; lateral wall thick, smooth, straight, swollen at Joints; cross wall thin, lumen

narrow; content translucent. Distrib. : Calyx. (Fig. 353)

7. UNISERiate CONICAL HAIR.

Foot : Simple. Body : 3-4 celled, entire, elongated, conical; cells of varied length & longer than breadth; tip pointed; lateral walls thick, smooth, straight, swollen at Joints; cross wall thin, lumen narrow; content translucent. Distrib. : calyx. (Fig. 354)

8. UNISERiate HOOKED HAIR.

Foot : Simple. Body : 3-celled, entire, elongated, hooked; cells of varied length & longer than breadth, middle cell curved; tip pointed; lateral walls thick ; rugose, straight, Joints distinct; cross walls thin; lumen narrow; content opaque. Distrib. : Stem. (Fig. 355)

9. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 1-celled, shorter than head rectangular, thin & smooth walled, content translucent; head 1-celled, distinct, elliptical, thin walled, content dense granular.

Distrib. : Stem, petiole, leaf & calyx. (Fig. 356)

10. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 2-celled, erect, elongated, basal cell longer than breadth & base wider, upper cell isobilateral thin walled, content translucent; head 1--celled, capitate, globose, thin walled, content granular. Distrib. : Leaf-margin and calyx. (Fig. 357)

LEUCAS PROCUMBENS

There are eight type of trichomes observed in this plant. (Plate 36 fig. 358-365)

1. UNICELLULAR CONICAL HAIR.

Foot : Not visible. Body : Entire, stout, conical, cell short and sharply tapering; tip pointed; wall thick, smooth, straight; lumen wide; content opaque. Distrib. : Leaf, calyx. (Fig. 358)

2. BICELLULAR ASEPTATE FLAGELLATE HAIR.

Foot : Simple. Body : 2-celled, entire, long,

flagellate; basal cell short, erect, upper cell long & flagellate; tip obtuse; lateral & cross walls thin, rugose, lumen wide; content opaque. Distrib. : Corolla. (Fig. 359)

3. BICELLULAR ACUMINATE HAIR.

Foot : Simple. Body : 2-celled, hooked; cells longer than breadth; tip pointed; lateral walls thick, rugose, straight, swollen at Joint, cross walls thick; lumen narrow; content translucent. Distrib. : Stem, petiole, leaf & calyx. (Fig. 360)

4. BICELLULAR ACUMINATE HAIR.

Foot : Compound. Body : 2-celled, entire, very long, acuminate; cells of varied length & tapering; tip pointed; lateral walls thin, rugose, straight; cross walls thin; lumen narrow; content opaque. Distrib. : Calyx & corolla. (Fig. 361)

5. UNISERIATE FILIFORM HAIR.

Foot : Simple. Body : 3-4 celled, entire, filiform; cells of varied length & narrowly elongated;; tip pointed, lateral & cross walls thin, rugose, straight, slightly swollen at Joints; lumen narrow;

content opaque. Distrib. : Calyx, corolla. (Fig. 362)

6. UNISERiate CURVED HAIR.

Foot : Compound. Body : 3-4 celled, curved; basal cell short, remaining longer than breadth & long; tip pointed; lateral & cross walls thick, rugose, swollen at Joints; lumen narrow; content opaque. Distrib. : Stem. (Fig. 363)

7. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 1-celled, short, wider than length, walls thin & smooth, lumen wide content translucent; head 1-celled, large, capitate, globose, wall thick content opaque. Distrib. : Stem, petiole, leaf surface, calyx & corolla. (Fig. 364)

8. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk; 2-celled; basal cell much longer and wider than upper short, rectangular, walls thin & smooth, content translucent; head 1-celled, capitate, globose, thick walled, content dense granular. Distrib. : calyx & corolla. (Fig. 365)

LEUCAS BIFLORA

This species shows twelve type of trichomes (Plate 36 Fig. 366 - 377)

1. UNICELLULAR PAPILLOSE HAIR.

Foot : Simple. Body : 1-celled, papillose; cell longer than breadth, tip rounded; wall thin, smooth, straight or convex; lumen wide; content translucent. Distrib: Stem, leaf lower surface & margin, calyx & corolla. (Fig.366)

2. UNICELLULAR FLAGELLATE HAIR.

Foot : Simple. Body : Entire, long, flagellated; cell hyaline, narrow, long, tip flexuously pointed; walls thin, smooth, lumen narrow; content translucent. Distrib. : calyx & corolla. (Fig.367)

3. UNICELLULAR ACUMINATE HAIR.

Foot : Simple. Body : 1-celled, entire, acuminate, cell sharp & narrowly elongated; tip sharply pointed; walls thin, smooth, straight, lumen narrow; content translucent. Distrib.: calyx & corolla. (Fig.368)

4. UNICELLULAR DENTATE HAIR.

Foot : Compound. Body : 1-celled, stiff, dentate; cell longer than breadth & turn slightly, one face convex; tip pointed; walls thick, smooth; lumen narrow; content opaque. Distrib.: Leaf, bract & calyx (Fig. 369)

5. BICELLULAR CYLINDRICAL HAIR.

Foot : Compound. Body : 2-celled, erect, elongated, cylindrical; cells longer than breadth, lower cell longer than upper and base wide; tip pointed; lateral walls thick, smooth, straight; joint distinct; cross wall thin, lumen varied; content opaque. Distrib.: leaf-margin, (Fig. 370)

6. BICELLULAR CONICAL HAIR.

Foot : Compound. Body : Entire, elongated, conical; cell of varied length and longer than breadth; upper cell sharply tapering to a pointed tip; lateral walls thick or thin, rugose, straight, swollen at joints; cross wall thick; lumen narrow; content opaque. Distrib.: Stem leaf, bract, calyx & corolla. (Fig. 371)

Explanation of the figures of Plate 36.

Trichomes from Various Plant parts.

Figs. 355 - 357 : *L. mollissima*.

Figs. 355, 356	:	Stem.
Fig. 357	:	Leaf margin.

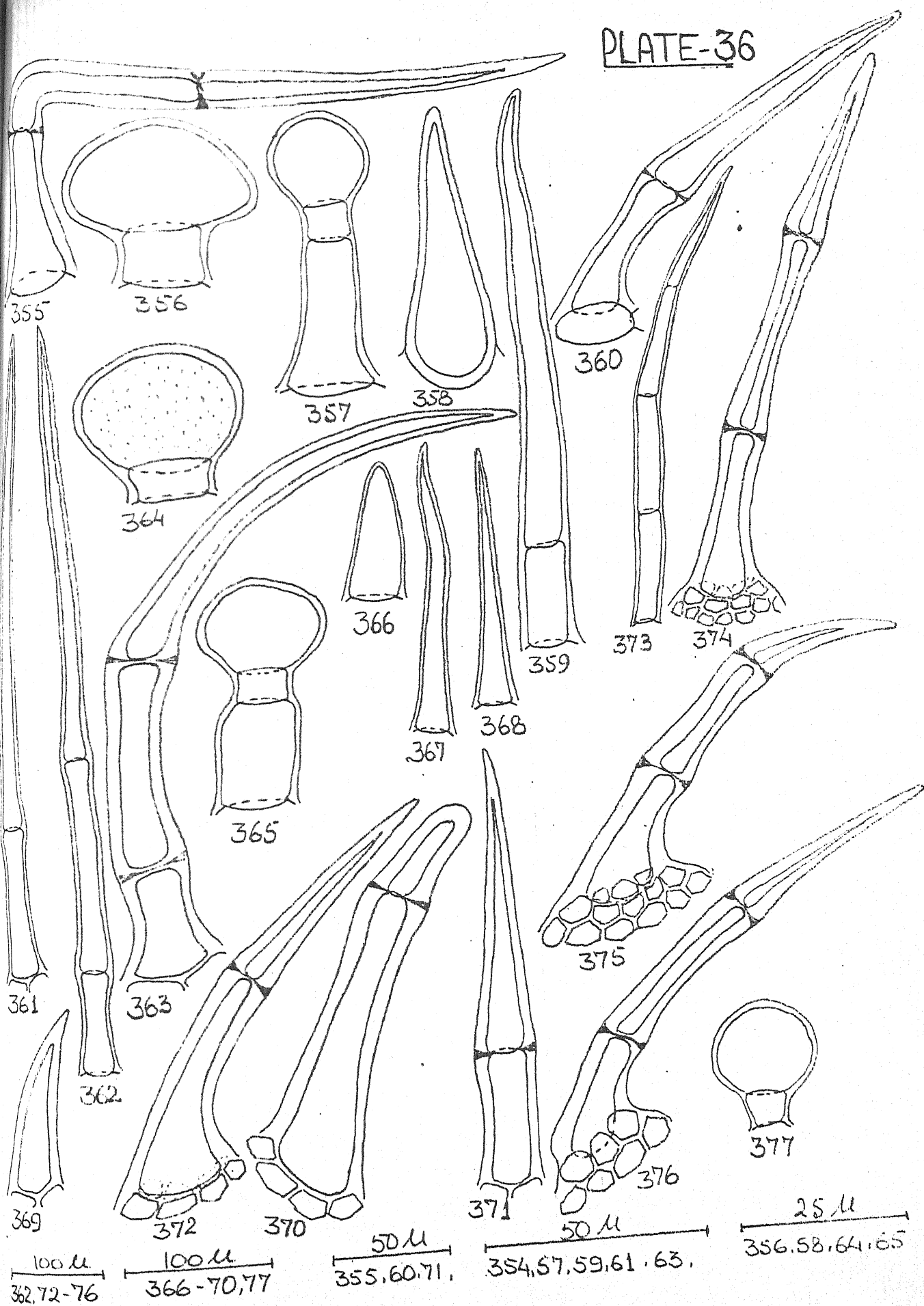
Figs. 358 - 365 : *L. procumbens*.

Fig. 358	:	Leaf lower.
Figs. 359, 362	:	Corolla
Figs. 360, 361, 365	:	Calyx.
Figs. 363, 364	:	Stem.

Figs. 366 - 377 : *L. biflora*.

Figs. 366, 368	:	Calyx.
Figs. 367, 371	:	Stem.
Figs. 369, 374	:	Leaf upper.
Figs. 370, 372, 375, 376, 377	:	Leaf margin.
Fig. 378	:	Corolla.

PLATE-36



7. BICELLULAR HOOKED HAIR.

Foot : Compound. Body : 2 celled, arrect, hooked; cell longer than breadth, base spreaded; tip pointed; lateral walls thick, smooth, joints distinct; cross walls thick; lumen narrow; content translucent. Distrib. : Stem, leaf, bract, calyx & corolla. (Fig. 372)

8. UNISERiate FILIFORM HAIR.

Foot : Simple. Body: 3-5 celled, long filiform; cell narrowly elongated; tip pointed; lateral walls thin, smooth; cross walls thin; lumen wide; content translucent. Distrib. : Corolla. (Fig. 373)

9. UNISERiate CONICAL HAIR.

Foot : Simple. Body: 3-4 celled, entire, conical; cells longer than breadth, narrow; tip pointed; lateral walls thick, smooth, straight; Joint distinct & swollen; cross walls thick; lumen narrow content opaque. Distrib. : Leaf lower surface & bract. (Fig. 374)

10. UNISERiate CURVED HAIR.

Foot : Simple. Body: 3-4 celled, entire, curved;

cells longer than breadth, base wide; lateral walls thick, smooth, Joints distinct & swollen; lumen narrow; content translucent. Distrib. : Stem, leaf-margin, calyx. (Fig. 375)

11. UNISERIATE HOOKED HAIR.

Foot: compound Body: 3-4 celled, entire, elongated, hooked; cells longer than breadth, base wide; tip pointed; lateral wall thick, smooth or rugose, swollen at joints; cross wall thick; lumen narrow; content translucent. Distrib.: Stem, leaf margin calyx. (Fig. 376)

12. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, shorter than head, rectangular, thin walled & smooth, content translucent; head 1-celled, globose, thin walled, content light green yellow. Distrib.: Stem, leaf-surface, bract, calyx, corolla, & stamen. (Fig. 377).

LEUCAS = STELLIGERA

This plant shows ten type of trichomes. (Plate 37 Fig. 378-387)

1. UNICELLULAR CONICAL HAIR.

Foot : Simple. Body : 1- celled, entire, conical; cell elongated base wide & tapering to a pointed tip; walls thin; rugose, straight; lumen narrow; content translucent. Distrib. : Stem & bract. (Fig. 378)

2. BICELLULAR ASEPTATE FLAGELLATE HAIR.

Foot : Simple. Body : 2- celled, differentiated; basal cell straight, upper cell much elongated, flexuous; tip pointed; lateral walls thin, rugose; cross walls thin; lumen wide; content translucent. Distrib. : Stem, leaf. Infl. axis, bract & calyx. (Fig. 379)

3. BICELLULAR HOOKED HAIR.

Foot : Compound. Body : 2-celled. arrect, hooked; cells elongated & of equal size, parallel to surface, base broad; tip pointed; lateral and cross walls thick, smooth, swollen at Joint; lumen narrow; content translucent. Distrib. : Stem, leaf, bract & calyx. (Fig. 380)

4. UNISERIATE FILIFORM HAIR.

Foot : Compound. Body : 3-4 celled, entire, very

long, filiform; tip pointed; lateral & cross walls thick, rugose, swollen at Joints; lumen narrow; content opaque. Distrib. : Stem. Leaf surface. Infl. axis, bract. (Fig. 381)

5. UNISERiate SEPTATE FLAGELLATE HAIR.

Foot : Compound. Body : 3-6 celled, narrow, elongated, flagellated. Cells longer than breadth; tip pointed; lateral & cross walls thin, rugose, flexuous; lumen narrow; content translucent. Distrib. : Bract, calyx, corolla. (Fig. 382)

6. UNISERiate CONICAL HAIR.

Foot : Simple. Body : 3-4 celled, entire, elongated, erect, conical; cells long; tip pointed; lateral and cross walls thin, rugose, straight, swollen at joints; lumen wide; content translucent. Distrib. : Leaf-surface, calyx. (Fig. 383)

7. UNISERiate CURVED HAIR.

Foot : Compound. Body : 3-5 celled, elongated, curved; cells curved & longer than breadth, base broad; tip pointed; lateral & cross walls thick, rugose or smooth, joints distinct & swollen; lumen

narrow; content translucent or opaque. Distrib. :
Stem, leaf surface. Infl.axis, calyx. (Fig. 384)

8. UNISERIATE HOOKED HAIR.

Foot : Compound. Body : 3-5 celled, entire, elongated, hooked; cells elongated, narrow, base wide; tip pointed; lateral walls thick or thin, rugose, Joint distinct & swollen; cross walls thick; lumen narrow; content opaque. Distrib. : Stem, leaf, Infl.axis, calyx. (Fig. 385)

9. PELTATE HAIR.

Foot : Not visible. Body : Multicellular, shield, like, circular in shape, parallel to epidermis, 1-celled in thickness, 6-10 celled in diameter, cells rectangular, radiating from center; outer wall thin, entire, lateral walls thin; content dense. Distrib. : Leaf-surface, calyx. (fig. 386)

10. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 2-celled, short, cells rectangular, thin walled, smooth, content translucent; head 1-celled, inflated, thin walled, smooth, content golden yellow. Distrib. : Stem, leaf-margin, Infl.axis, calyx. (Fig. 387)

LEUCAS NUTANS

This species shows ten type of trichomes (Plate 37 Fig. 388-398)

1. UNICELLULAR PAPILLOSE HAIR.

Foot : Simple (Fig. 388) or Compound (Fig. 389). Body : 1-celled, papillose; cell small and wide or narrowly elongated; tip rounded or obtuse; walls thin or thick, smooth, convex or straight; lumen wide or narrow; content translucent. Distrib. : Fig. 388 - corolla & stamen; Fig. 389 - bract.

2. UNICELLULAR CONICAL HAIR.

Foot : Simple. Body : 1-celled, very long, erect, conical; cell longer than breadth, base broad, sharply tapering; tip pointed; walls thin, smooth, straight; lumen wide; content translucent. Distrib. : Stem, leaf, bract, & calyx. (Fig. 390)

3. BICELLULAR FILIFORM HAIR.

Foot : Simple. Body : 2-celled, entire, filiform; cells narrowly elongated; tip pointed; lateral walls thin, smooth, straight; cross wall thin; lumen narrow; content translucent. Distrib. : calyx. (Fig.

391)

4. BICELLULAR ASEPTATE FLAGELLATE HAIR.

Foot : Simple. Body : 2- celled, elongated, differentiated, flagellate; basal cell comparatively short, erect, upper cell much elongated, flagellate; tip pointed; lateral & cross walls thin, rugose or smooth, swollen at Joint; lumen wide; content opaque. Distrib. : Calyx. (Fig. 392)

5. BICELLULAR CONICAL HAIR.

Foot : Simple. Body : 2-celled, entire, elongated, conical, cells of equal size & longer than breadth, upper cell cony; tip pointed; lateral & cross walls thin, smooth, straight, Joint swollen; lumen wide; content translucent. Distrib. : Stem, leaf & calyx. (Fig. 393)

6. BICELLULAR HOOKED HAIR.

Foot : Compound. Body : 2-celled, hooked; cells of varied length & longer than breadth, base broad; tip obtuse; lateral walls thick, smooth, straight, Joint distinct & swollen; cross walls thick; lumen varied; content translucent. Distrib. : Stem, leaf, bract &

calyx. (Fig. 394)

7. UNISERiate CYLINDRICAL HAIR.

Foot : Simple. Body : 3-6 celled, uniseriate cylindrical, cells of varied length and shape; tip rounded, lateral and cross walls thin, smooth, irregular; lumen wide; content translucent. Distrib. : Bract. (Fig. 395)

8. UNISERiate HOOKED HAIR.

Foot : Compound. Body : 3-4 celled, hooked; cells long, wide, at Joints basal cell biconcave, curved; tip pointed; lateral & cross walls thick or thin, smooth; straight, lumen narrow; content opaque. Distrib. : Stem, bract & calyx. (Fig. 396)

9. UNISERiate FILIFORM HAIR.

Foot : Simple. Body : 3-5 celled, very long, filiform, cells of equal length and much longer than breadth; tip pointed, lateral and cross wall thin, smooth, straight; lumen wide; content opaque. Distrib. : Stem, calyx, corolla. (Fig. 397)

10. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 1-celled, short, much wider than long, collared, wall thin; content translucent head 1-celled, large, inflated, thin walled, content opaque. Distrib. : Leaf-surface, bract, calyx & ovary wall. (Fig. 398)

LEUCAS MARTINICENSIS

There are ten type of trichomes in this species.
(Plate 37 & 38 Fig. 399-409)

1. UNICELLULAR PAPILLOSE HAIR.

Foot : Simple. Body : 1-celled, long, hyaline, papillose, cell longer than breadth & of varied shapes; tip rounded; wall thin, smooth; lumen wide; content translucent. (Fig. 399)

2. UNICELLULAR CONICAL HAIR.

Foot : Simple. Body : Entire, long, conical; cell longer than breadth; tip pointed; walls thick, smooth; lumen wide; content translucent. Distrib. : Leaf-surface and bract. (Fig. 400)

Explanation of the figures of Plate 37.

Trichomes from Various Plant parts.

Figs. 378 - 387 : *L. stelligera*.

Figs. 378, 382	:	Bract.
Fig. 379	:	Infl. axis.
Figs. 380, 387	:	Leaf margin.
Figs. 381, 384, 385	:	Stem.
Figs. 383, 386	:	Leaf upper.

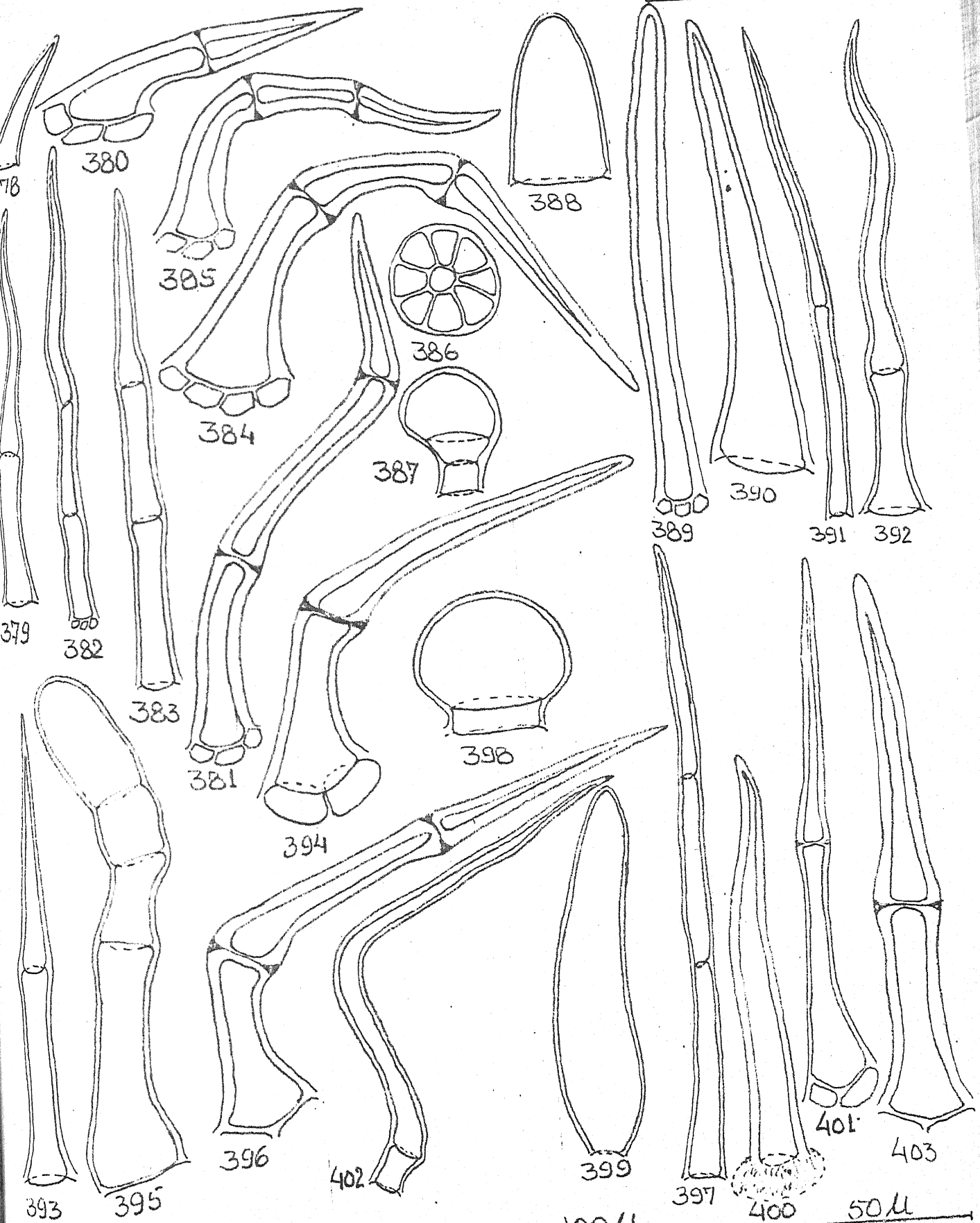
Figs. 388 - 398 : *L. nutans*.

Figs. 388, 397	:	Corolla.
Figs. 389, 395, 398	:	Bract.
Figs. 390, 394, 396	:	Stem.
Figs. 391, 392	:	Calyx.
Fig. 393	:	Leaf upper.

Figs. 399 - 403 : *L. martinicensis*.

Figs. 399, 402	:	Corolla.
Fig. 400	:	Calyx.
Fig. 401	:	Petiole.
Fig. 403	:	Leaf lower.

PLATE-37



100 μ
382, 97

200 μ
378-81, 83-86, 91, 92, 99, 401

100 μ
393, 94, 96, 402.

50 μ
387, 90, 95, 98, 400, 03

3. BICELLULAR ACUMINATE HAIR.

Foot : Compound. Body : 2-celled, elongated, acuminate, cells narrowly elongated & of equal size; upper cell sharply pointed; lateral walls thin; smooth, straight, swollen at Joint; cross walls thin; lumen narrow; content translucent. Distrib. : Petiole. (Fig. 401)

4. BICELLULAR ASEPTATE FLAGELLATE HAIR.

Foot : Simple. Body : 2-celled, differentiated; basal cell short, erect, rectangular, upper cell very long, flagellate; tip pointed; lateral and cross walls thin, rugose, constricted at joint; lumen wide; content opaque. Distrib. : Corolla. (Fig. 402)

5. BICELLULAR CONICAL HAIR.

Foot : Compound. Body : 2-celled, entire, elongated, conical; cells longer than width, upper cell tapering to a pointed tip; lateral and cross walls thick, smooth, straight, swollen at joint; lumen wide; content translucent. Distrib. : Leaf-surface & calyx. (Fig. 403)

6. BICELLULAR HOOKED HAIR.

Foot : Compound. Body : 2-celled, entire, long, hooked; basal cell biconcave, long, erect, upper cell very long; tip pointed; lateral and cross walls thick, smooth, joint swollen and distinct; lumen narrow; content translucent. Distrib. : Stem, petiole, leaf & calyx. (Fig. 404)

7. UNISERiate FILIFORM HAIR.

Foot : Simple. Body : 3-6 celled, very long, filiform; cells of varied length & longer than breadth; tip pointed; lateral & cross walls thin, smooth or rugose, straight, swollen at joints; lumen wide; content opaque. Distrib. : Corolla. (Fig. 405)

8. UNISERiate HOOKED HAIR.

Foot : Compound (Fig. 406) or Simple (Fig. 407)_Body : 3-4 celled, entire, elongated, hooked; cell longer than breadth & of varied length; tip pointed; lateral and cross walls thick and smooth (fig.406) or thin and rugose (Fig.407) straight, joint swollen; narrow; content translucent. Distrib.: (Fig. 406)
Stem, petiole, leaf-surface, calyx; (Fig.407)
corolla.

9. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 1-celled, short, rectangular, thin walled, content translucent; head 1-celled, globose; capitate, thin walled, content opaque. Distrib. : Stem, petiole, leaf-surface, calyx & corolla. (Fig. 408)

10. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 2-celled, short, base wide, cells rectangular, thick walled, content translucent; head 1-celled, large, capitate, globose, thick walled; content opaque. Distrib. : Calyx & corolla. (Fig. 409)

LEUCAS CEPHALOTUS

This plant shows eleven type of trichomes (Plate 38 Fig. 410 - 420)

1. UNICELLULAR PAPILLOSE HAIR.

Foot : Simple. Body : 1-celled, variously papillose, cell elongated than breadth; tip rounded or obtuse, walls thin, smooth, lumen wide, content light yellow. Distrib. : Bract & calyx. (Fig. 410)

2. UNICELLULAR CONICAL HAIR.

Foot : Simple. Body : 1-celled, long, conical; base bulbous; tip obtuse, walls thin, smooth; lumen wide; content opaque. Distrib. : Leaf-surface margin, bract & calyx. (Fig. 411)

3. BICELLULAR FILIFORM HAIR.

Foot : Simple. Body : 2-celled, entire, elongated, filiform; cells of equal length & longer than breadth; tip obtuse; lateral walls thick, smooth, straight, joint swollen; cross wall thin; lumen narrow; content opaque. Distrib. : Petiole, leaf, Infl. axis, bract & corolla. (Fig. 412)

4. BICELLULAR CYLINDRICAL HAIR.

Foot : Simple. Body : 2-celled, long, cylindrical; tip rounded; lateral and cross walls thin, smooth, straight, swollen at joint; lumen wide; content translucent. Distrib. : Stem, leaf lower surface. (Fig. 413)

5. BICELLULAR HOOKED HAIR.

Foot : Compound. Body : 2-celled, hooked; cells wide,

longer than breadth; tip upward & pointed; lateral walls thick, smooth, joint swollen and distinct; cross wall thick; lumen wide; content translucent. Distrib. : Stem, bract & calyx. (Fig. 414)

6. UNISERiate ACERATE HAIR.

Foot : Simple. Body : 3-4 celled, very long, acerate, cells narrowly elongated, terminal cell longest; tip sharply pointed; lateral and cross walls thin, rugose, straight; lumen narrow; content opaque. Distrib. : Stem, Infl. axis, corolla. (Fig. 415)

7. UNISERiate FILIFORM HAIR.

Foot : Simple. Body : 3-4 celled, entire, elongated, filiform; cells long; tip obtuse or pointed; lateral & cross walls thin, smooth or rugose; straight; lumen wide; content opaque. Distrib. : Infl. axis, bract, calyx, corolla. (Fig. 416)

8. UNISERiate CYLINDRICAL HAIR.

Foot : Compound. Body : 3-4 celled, cylindrical; cells of varied length & breadth; tip rounded; lateral walls thick, smooth, joints swollen, cross walls thin; lumen wide; content translucent. Distrib.

Explanation of the figures of Plate 38.

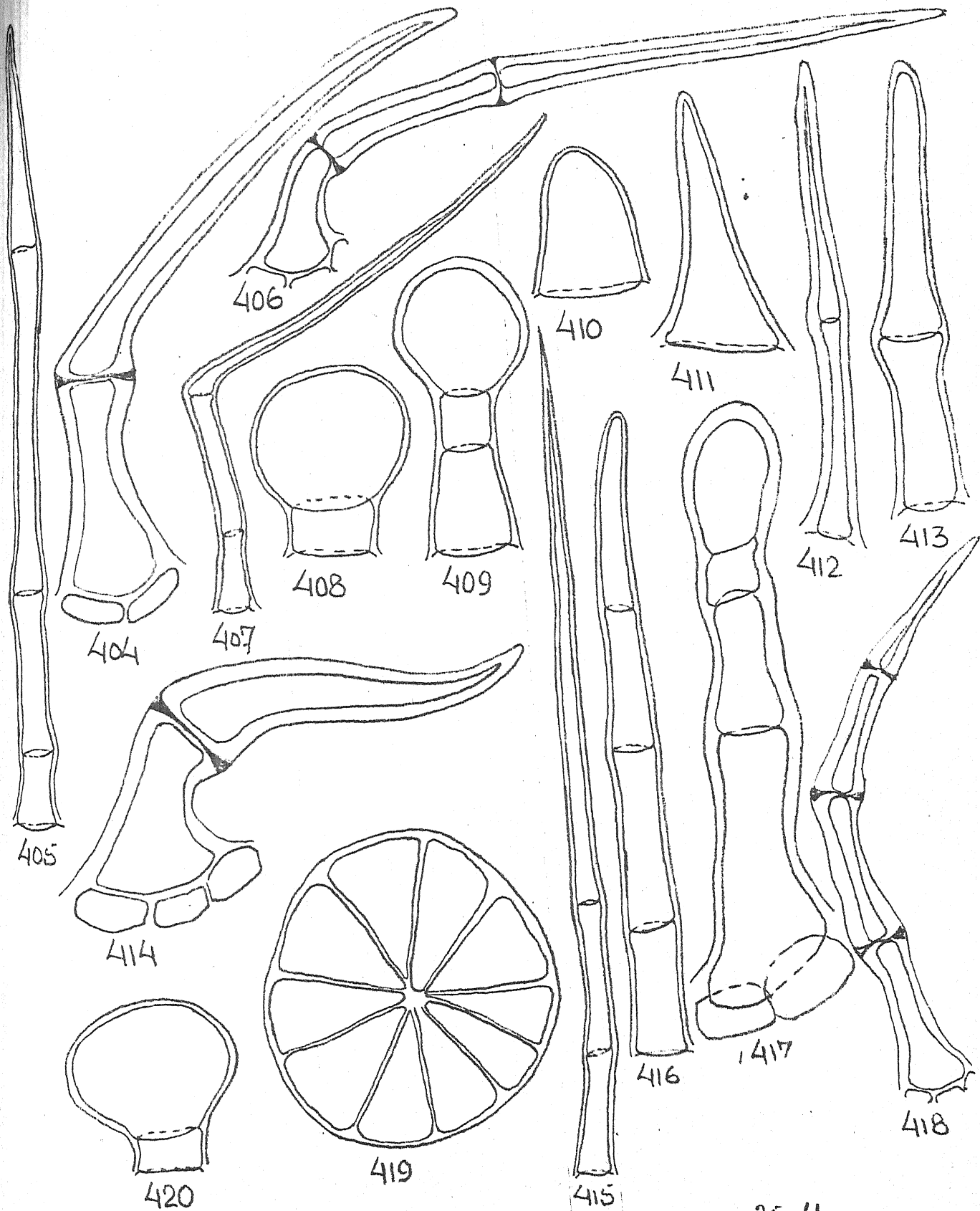
Trichomes from Various Plant parts.

Figs. 404 - 409 : *L. martinicensis*.

Figs. 404, 409	:	Calyx.
Figs. 405, 407	:	Corolla
Figs. 406, 408	:	Stem.

Figs. 410 - 420 : *L. cephalotus*.

Figs. 410, 411, 412, 417	:	Bract.
Figs. 413, 414, 418	:	Stem.
Fig. 415	:	Petiole.
Fig. 416	:	Corolla
Fig. 419	:	Leaf upper.
Fig. 420	:	Calyx.



100 μ
405, 12, 18.

100 μ
406, 7, 13-15,

50 μ
404, 11, 16, 17, 19

25 μ
408, 09, 10, 20

: Bract, calyx & corolla. (Fig. 417)

9. UNISERiate CURVED HAIR.

Foot : Compound. Body : 3-4 celled, entire, curved; cells biconcave, longer than breadth; tip pointed; lateral & cross walls thick, smooth, straight, joint swollen and distinct; lumen narrow; content opaque.

Distrib. : Stem, petiole, leaf. (Fig. 418)

10. PELTATE HAIR.

Foot : Not visible. Body : Shield like, circular, parallel to epidermis, one celled in thickness, 8-12 celled in diameter; cells triangular, radiating from center, outer walls thin; lateral walls thin; content translucent. Distrib. : Leaf-lower surface. (Fig. 419)

11. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 1-celled, short, rectangular, thin walled, content translucent; head 1-celled large, capitate, globose, thin walled, content opaque. Distrib. : Calyx. (Fig. 420)

LEUCAS ASPERA

There are ten type of trichomes present in this species (Plate 39 Fig. 421-430)

1. UNICELLULAR CONICAL HAIR.

Foot : Simple. Body : 1-celled, elongated, conical; cell much longer and tapering, base wide; tip obtuse; walls thick, smooth, straight; lumen wide; content translucent. Distrib. : Stem, leaf bract & calyx. (Fig. 421)

2. BICELLULAR SEPTATE FLAGELLATE HAIR.

Foot : Simple. Body : 2-celled, flagellate; cells long, narrow, flagellate, cells of unequal size, lower cell elongated, but upper cell more elongated; tip pointed; lateral and cross walls thin, smooth; lumen narrow; content translucent. Distrib. : Corolla. (Fig. 422)

3. BICELLULAR CYLINDRICAL HAIR.

Foot : Simple. Body : 2-celled, elongated, cylindrical; cells long and of unequal size, upper cell longer; tip obtuse; lateral and cross walls

thin, smooth, straight, joint swollen; lumen wide; content translucent. Distrib. : Stem, leaf lower surface, bract, calyx. (Fig. 423)

4. BICELLULAR CONICAL HAIR.

Foot : Compound. Body : 2-celled, entire, erect, elongated, conical; tip obtuse; lateral walls thick, smooth, straight, joint swollen & distinct; cross wall thick; lumen wide; content translucent. Distrib. : Leaf, calyx, corolla. (Fig. 424)

5. BICELLULAR HOOKED HAIR.

Foot : Compound. Body : 2-celled, entire, hooked; cells much longer than breadth, upper cell curved upon basal erect cell; tip pointed; lateral & cross walls thick, rugose, joint distinct and swollen; lumen wide; content translucent. Distrib. : Stem, leaf-lower surface. (Fig. 245)

6. UNISERiate FILIFORM HAIR.

Foot : Compound. Body : 3-4 celled, entire, elongated, filiform; cells of variable length & longer than breadth; tip obtuse; lateral and cross

walls thin, smooth or rugose, straight, joint swollen and distinct; lumen wide or narrow; content translucent. Distrib. : Bract, calyx & corolla. (Fig. 426)

7. UNISERIATE HOOKED HAIR.

Foot : Compound. Body : 3-4 celled, entire, hooked; cells elongated, base wide; tip pointed; lateral walls thick, rugose, swollen at joint; cross walls thin; lumen variable; content translucent. Distrib. : Stem. (Fig. 427)

8. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 1-celled, shorter than head, rectangular, thin walled, content translucent; head 1-celled, large, capitate, globose, thin walled; content light yellow. Distrib. : Stem, leaf surface, bract, calyx & corolla. (Fig. 428)

9. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Compound. Body : Differentiated;; stalk 2-celled, upper cell short, collared, lower cell large, wide prominent & longer than breadth, lateral & cross walls thin, smooth, content translucent; head 1-

celled, large, capitate, globose, wall thin, content opaque. Distrib. : Leaf lower surface. (Fig. 429)

10. UNISERIATE GLANDULAR CAPITATE HAIR.

Foot : Compound. Body : Differentiated; stalk 3-4 celled, cells of unequal size and shape; cells gradually decreasing in size, lateral & cross walls thin, content translucent; head 1-celled, globose; content light yellow. Distrib. : Leaf lower surface, calyx & corolla. (Fig. 430)

LEUCAS LINIFOLIA

This species shows eight type of trichomes. (Plate 39 Fig. 431-438)

1. UNICELLULAR CONICAL HAIR.

Foot : Simple. Body : 1-celled, elongated, conical; tip pointed; walls thick, smooth, lumen narrow; content translucent. Distrib. : Leaf lower surface & margin, bract & calyx. (Fig. 431)

2. BICELLULAR ASEPTATE FLAGELLATE HAIR.

Foot : Simple. Body : 2-celled, narrowly elongated, flagellate, differentiated; lower cell stout, short, rectangular; upper cell narrow, flagellate, very long; lateral and cross walls thin, smooth; lumen narrow; content opaque. Distrib. : Corolla. (Fig. 432)

3. BICELLULAR CONICAL HAIR.

Foot : Simple. Body : Entire, elongated, conical; cells longer than breadth; tip pointed; lateral walls thick, smooth, straight, joint distinct; cross wall thin; lumen wide; content translucent. Stem, leaf, bract; calyx. (Fig. 433)

4. BICELLULAR HOOKED HAIR.

Foot : Simple. Body : 2-celled, entire, long, hooked, cells wide and longer than width; tip pointed; lateral walls thick, smooth, straight; cross wall thick; lumen wide; content translucent. Distrib. : Stem, leaf, bract, calyx. (Fig. 434)

5. UNISERIATE FILIFORM HAIR.

Foot : Simple. Body : 3-4 celled, entire, elongated, filiform; cells of varied length & long; tip pointed;

Explanation of the figures of Plate 39.

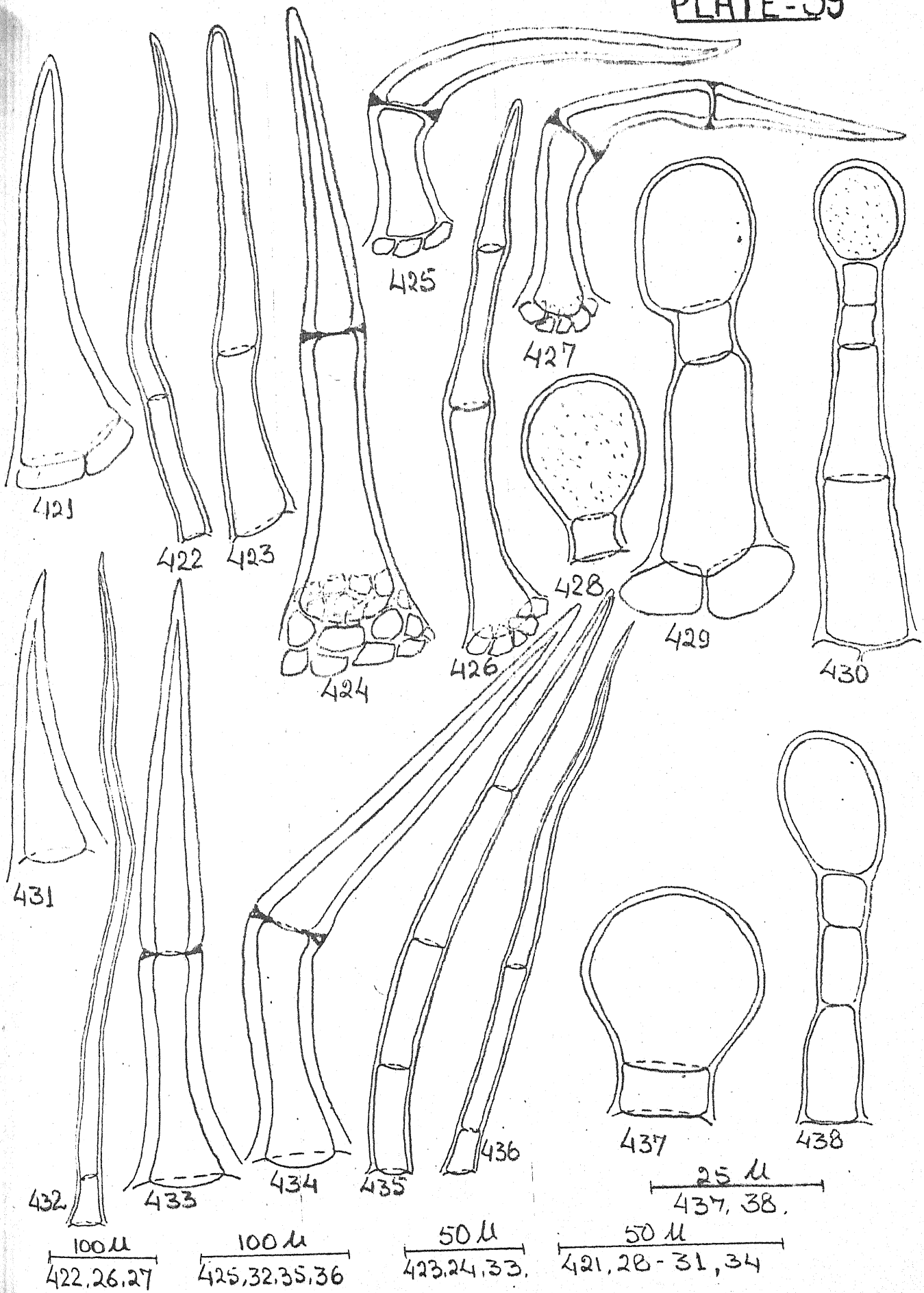
Trichomes from Various Plant parts.

Figs. 421 - 430 : *L. aspera*.

Fig. 421	:	Leaf lower.
Figs. 422, 428	:	Corolla.
Fig. 423	:	Calyx.
Figs. 424, 425, 427, 430	:	Bract.
Fig. 426	:	Stem.
Fig. 429	:	Leaf upper.

Figs. 431 - 438 : *L. linifolia*.

Figs. 431, 435	:	Calyx.
Figs. 432, 436	:	Corolla.
Figs. 433, 434	:	Stem.
Fig. 437	:	Leaf upper.
Fig. 438	:	Bract.



lateral and cross walls thin, smooth, straight; lumen wide; content translucent. Distrib. : Calyx. (Fig. 435)

6. UNISERIATE ASEPTATE FLAGELLATE HAIR.

Foot : Simple. Body : 3-5 celled, differentiated; lower most cell short, rectangular, thin walled; upper 2-3 cells long; middle cells, rectangular, thin walled; upper most cell flagellated narrowly elongated; lumen narrow; content translucent. Distrib. : Corolla. (Fig. 436)

7. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 1-celled wider than long and smaller than head, thin walled, content translucent; head 1-celled, large, globose, wall thin, content light yellow. Distrib. : Stem, leaf, calyx & corolla. (Fig. 437)

8. UNISERIATE GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 3-4 celled, cells of variable length, walls thin & smooth, content translucent; head 1-celled, large, globose, thin walled, content light yellow. Distrib.

: Calyx & corolla. (Fig. 438)

LEONOTIS NEPETAEFOLIA

This plant shows fourteen type of trichomes. (Plate 40 Fig. 439-452)

1. UNICELLULAR PAPILLOSE HAIR.

Foot : Simple. Body : 1-celled, elongated, papillose; cell wide & elongated, cylindrical; tip rounded; walls thin, smooth; lumen wide; content translucent. Distrib. : Corolla (Fig. 439)

2. UNICELLULAR CONICAL HAIR.

Foot : Simple. Body : stiff, erect, conical; cells elongated, sharply tapering; tip pointed; walls thick, smooth, straight; lumen narrow; content opaque. Distrib. : Calyx. (Fig. 440)

3. BICELLULAR ASEPTATE FLAGELLATE HAIR.

Foot : Simple. Body : 2-celled, differentiated; lower cell small, stout; upper cell very long, flagellate; tip pointed; walls thin, smooth, wavy; lumen narrow; content translucent. Distrib. : Calyx & corolla. (Fig. 441)

4. BICELLULAR CYLINDRICAL HAIR.

Foot : Simple. Body : 2-celled, long, cylindrical, cells longer than breadth, upper cell much longer than lower; tip obtuse; lateral and cross walls thin, smooth; lumen wide; content translucent. Distrib. : Corolla. (Fig. 442)

5. BICELLULAR CONICAL HAIR.

Foot : Simple. Body : 2- celled, entire, long, conical; basal cell oblong, upper cell elongated and tapering; tip pointed; lateral walls thin, cross walls thin, smooth, or rugose, straight & swollen at joint; ; lumen wide; content translucent. Distrib. : Stem, petiole, leaf, bract, calyx & corolla. (Fig. 443)

6. BICELLULAR HOOKED HAIR.

Foot : Simple. Body : 2-celled, elongated, hooked; cells longer than breadth; tip pointed; lateral and cross walls thick, smooth or rugose, lumen wide; content translucent. Distrib. : Stem, petiole, leaf, bract and calyx. (Fig. 444)

7. UNISERIATE FILIFORM HAIR.

Foot : Simple. Body : 3-6 celled, elongated, filiform; cells longer than breadth; tip pointed; lateral and cross walls thin, rugose, swollen at joints; lumen narrow; content opaque. Distrib. : corolla. (Fig. 445)

8. UNISERiate SEPTATE FLAGELLATE HAIR.

Foot: Compound. Body: 3-6 celled, very long, flagellate; cells of varied length & narrow; tip pointed, lateral walls thin, smooth, flagellate; calyx & corolla. (Fig 446)

9. UNISERiate CURVED HAIR.

Foot: Compound. Body: 3-5 celled, elongated, curved; cells longer than breadth & of equal length; tip pointed; lateral & cross walls thick, content opaque. Distrib.:(Fig 447)

10. UNISERiate HOOKED HAIR.

Foot: Compound. Body: 3 celled, entire, hooked; cells of varied length, basal cell short and stout, upper cells long ; tip pointed ; lateral and cross walls thick smooth, straight, joint swollen ; lumen narrow

; content translucent. Distrib. : Stem, petiole, leaf, bract & calyx. (Fig 448)

11. UNISERiate ACUMINATE HAIR.

Foot: Simple. Body : 3-4 celled, elongated, differentiated, acuminate; basal cell wide, oblong, erect, remaining cells narrowly elongated; tapering to a long pointed end; lateral & cross walls thin, rugose, straight; lumen narrow; content opaque . Distrib. : Corolla. (Fig 449)

12. PELTATE HAIR.

Foot: Not visible, Body: Multicellular, shield like, circular, parallel to epidermis, 1-celled thickness; 4-6 cells in diameter, cells radiating from center; outer & lateral walls thin; content opaque. Distrib. : leaf surface, bract, calyx. (Fig 450)

13. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 1-celled, short, wider than length, thin walled, content translucent; head 1-celled, large, globose, thin walled, content golden yellow . Distrib. : Stem, petiole, leaf, bract, calyx, corolla, stamen . (Fig 451)

14. BICELLULAR GLANDULAR CAPITATE HAIR.

Foot: Simple. Body: Differentiated; stalk 2 celled, upper short, collared, lower cell long and prominent, lateral walls thin, smooth, content, translucent; head 1-celled, large, capitate, globular, wall thin, content opaque. Distrib. : Petiole & leaf surface. (Fig 452)

AJUGA BRACTEOSA

There are seven type of trichomes observed in this species. (Plate 40 fig. 453-459)

1. BICELLULAR CYLINDRICAL HAIR..

Foot : Simple. Body : 2-celled, entire, elongated, cylindrical; cells wide, longer than breadth; tip obtuse; lateral and cross walls thin, rugose, convex, constricted at joint; lumen wide; content hyaline. Distrib. : Corolla. (Fig. 453)

2. BICELLULAR CONICAL HAIR.

Foot : Simple. Body : 2-celled, conical, lower cell short, dome shaped, upper cell long tapering; tip

pointed; lateral and cross walls thin, rugose, convex, constricted at joint; lumen wide; content granulated yellowish. Distrib. : leaf surface & bract. (Fig. 454)

3. UNISERiate ASEPTATE FLAGELLATE HAIR.

Foot : Simple. Body : 3-14 celled, differentiated; stalk 2-13 celled, cells of varied length, lateral, and cross walls thin, rugose, lumen wide, content granulated yellow; terminal cell (head) 1- celled, narrowly elongated, flexuous, lumen varied, content granulated yellow. Distrib. : bract, calyx, (Fig. 455)

4. UNISERiate CONICAL HAIR.

Foot : Simple. Body : 3-10 celled, conical; cells wider than length; tip pointed; lateral and cross walls thin, rugose, convex, constricted at joints; lumen wide; content opaque. Distrib. : Leaf-surface, bract, calyx & corolla. (Fig. 456)

5. UNISERiate HOOKED HAIR.

Foot : Compound. Body : 3-12 celled, long, hooked, cells of basal region wider than length & upper region cells long & tapering to a pointed tip;

lateral and cross walls thin, rugose, straight, constricted at joint; lumen wide; content opaque. Distrib. : Stem, leaf, bract, calyx & corolla. (Fig. 457)

6. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 1-celled, short, collared, rectangular, thin walled, translucent; head 1-celled, capitate, globose, wall thin, content granulated yellow. Distrib. : Leaf-surface, bract, calyx, corolla. (Fig. 458)

7. UNISERIATE GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 2-5 celled, cells ovular, except upper short collar cell, wall thin, rugose, lumen wide, content opaque; head 1-celled, capitate, thin walled, content yellowish. Distrib. : Bract, calyx, corolla stamen. (Fig. 459)

AJUGA MACROSPERMA

It shows six type of trichomes (Plate 40 fig. 460-465)

1. UNISERIATE FILIFORM HAIR.

Foot : Compound. Body : 3-12 celled, entire, very long, filiform; cells wider, longer than breadth; except the terminal narrowly elongated cell; tip pointed; lateral and cross walls thin, rugose, straight, constricted at joint; lumen wide; content opaque. Distrib. : Stem, petiole, leaf-surface, corolla. (Fig. 460)

2. UNISERIATE SEPTATE FLAGELLATE HAIR.

Foot : Simple. Body : 3-8 celled, elongated, flagellate; cells of varied length and shape, basal cell short & wide, middle region cells longer than breadth, narrow and flagellate, terminal cell narrowly flagellate; tip sharply pointed; lateral and cross walls thin, rugose, wavy; lumen narrow, content opaque. Distrib. : calyx & corolla. (Fig. 461)

3. UNISERIATE CURVED HAIR.

Foot : Compound. Body : 3-6 celled, curved; cell wide, except terminal elongated; tip obtuse; lateral & cross walls thin, rugose, lumen wide, content opaque. Distrib. : Stem, petiole, leaf surface, bract, calyx & corolla. (Fig. 462)

Explanation of the figures of Plate 40.

Trichomes from Various Plant parts.

Figs. 439 - 452 : *Leonotis nepetacifolia*.

Figs. 439, 441, 442,	:	Corolla.
445, 449	:	
Figs. 440, 446, 447	:	Calyx.
Figs. 443, 448, 451	:	Stem.
Figs. 444, 452	:	Petiole.
Figs. 450	:	Leaf lower.

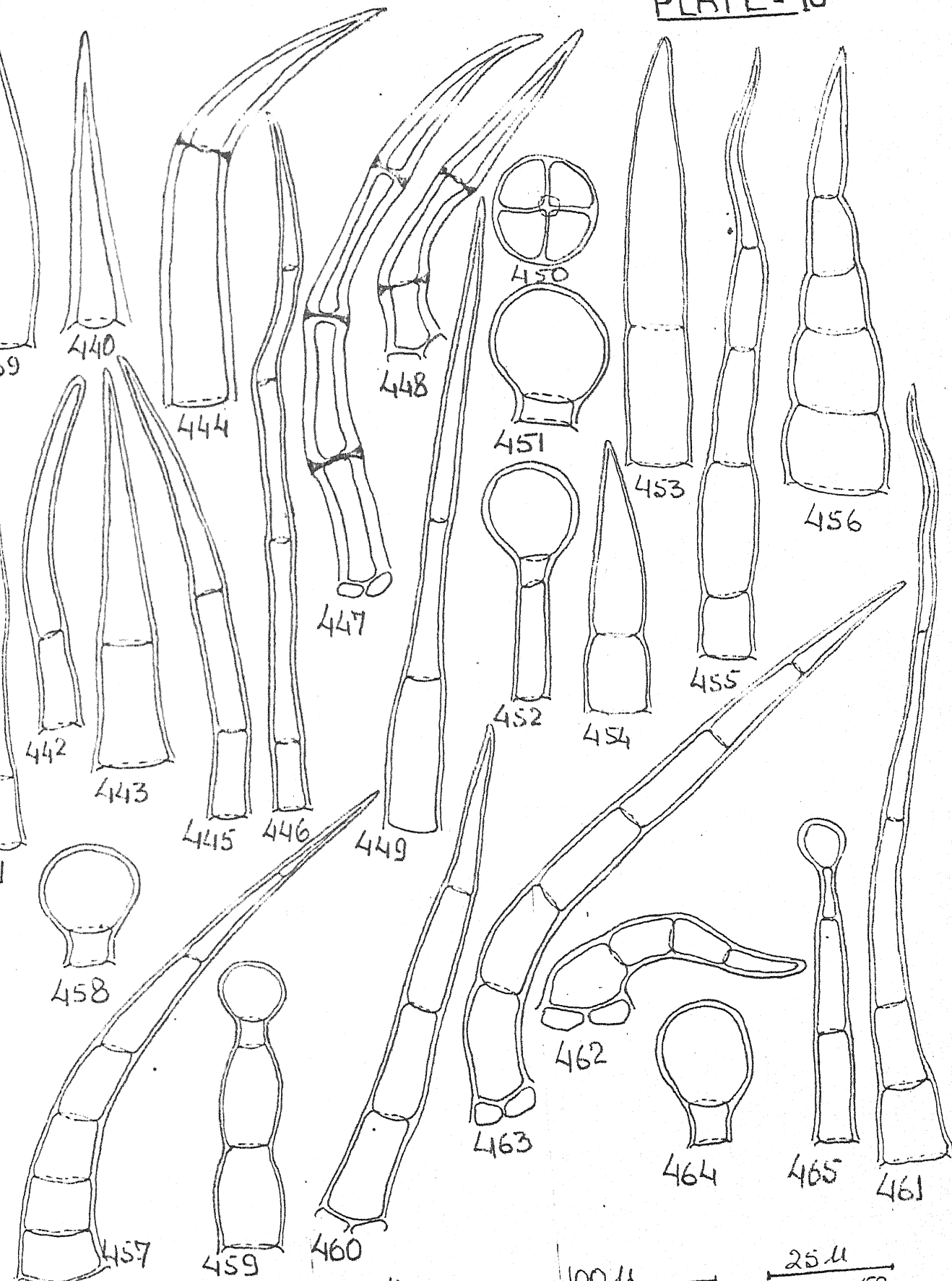
Figs. 453 - 459 : *Ajuga bracteosa*

Fig. 453	:	Corolla.
Figs. 454, 456, 458	:	Leaf upper.
Figs. 455, 457, 459	:	Bract.

Figs. 460 - 465 : *Ajuga macrosperma*.

Figs. 460, 462, 464	:	Stem.
Fig. 461	:	Calyx.
Fig. 463	:	Leaf margin.
Fig. 465	:	Bract.

PLATE - 40



$200\ \mu$
 441, 442, 446, 447, 449, 55, 57, 60, 61
 $100\ \mu$
 445, 53, 56, 62-65
 $100\ \mu$
 443, 44, 48, 50-52, 54, 58.
 $25\ \mu$
 439, 40, 59

4. UNISERiate HOOKED HAIR.

Foot : Compound. Body : 3-12 celled, elongated, hooked; cells longer than breadth, basal cell curved, remaining cells thin lumen wide; content opaque. Distrib. : Stem, petiole, leaf, bract, calyx & corolla. (Fig. 463)

5. UNICELLULAR GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 1 celled, smaller than head cubical, thin walled, content translucent; head 1-celled, large, rounded, thin walled, content yellowish. Distrib. : Stem, petiole, leaf-surface, bract, calyx & corolla. (Fig. 464)

6. UNISERiate GLANDULAR CAPITATE HAIR.

Foot : Simple. Body : Differentiated; stalk 2-3 celled, cells longer than breadth, lateral and cross walls thin, rugose, straight, lumen wide, except in upper cell, content opaque; head 1-celled, capitate, thick walled, content yellowish. Distrib. : Bract, calyx & corolla (Fig. 465)

B. OBSERVATION & DISCUSSION

In the present study a detailed investigation of the structure and distribution of vegetative & floral trichomes in 50 taxa of Lamiaceae has been taken into consideration with a view to assess taxonomic significance of these characters. Metcalfe & Chalk (1950) have reported the occurrence of 7-type of trichomes in Lamiaceae excluding Unicellular types. Various workers (Singh et al., 1974; Gupta & Bhambie 1978; Bosabalidis & Tsekos 1982, 1984; Olowokudejo & Shetealo 1988) explored the taxonomic significance but not at family level. In the present study a total number of 37 trichomes type both Non-glandular (34 types) & Glandular (3 types) has been recorded.

Trichomes are mainly classified into Non-glandular & Glandular types. The Non-glandular types are further categorized on the basis of number of cells, their arrangement and shape into Unicellular, Bicellular, Uniseriate, Dendroid, Stellate and Peltate types. Whereas, the Glandular types are divided into Unicellular glandular capitate,

Bicellular glandular capitate and Uniseriate glandular capitate (Table - VII).

The perusal of Tables (VIII, IX, X) reveals that most of the trichomes are present on both vegetative and floral parts, whereas, some are restricted to vegetative parts only. It is also interesting to note that some of the trichome types are freely observed on stamen and gynoecium of certain taxa and act as taxonomic marker. Some trichomes are common to most of the species while, others are not so common and their distribution is recorded in only 1-5 species. For example - Unicellular glandular capitate hairs are observed in 47 species; Bicellular conical in 37 species; Bicellular hooked and Unicellular hooked both in 34 species; Unicellular papillose in 28 species; Uniseriate filiform and Uniseriate conical both in 25 species; Uniseriate curved in 22 species; Bicellular glandular capitate and Uniseriate glandular capitate in 20 species. Whereas, Uniseriate aseptate flagellate, Uniseriate cylindrical, Uniseriate acerate are restricted to 5 of the taxa studied in the family Lamiaceae. Other types restricted to 3

taxa are - Unicellular arrect, Bicellular belemnoid and Uniseriate branched. Some types restricted to 2 taxa are Unicellular torulose, Bicellular curved, Bicellular acerate and Uniseriate furcate. Some of the trichomes type are restricted to only 1 taxa provide a distinct taxonomic significance and help in differentiating a species from the others viz., Unicellular acerate in Leucas urticaefolia, Unicellular acuminate in L. biflora, Unicellular curved in Micromeria biflora, dendroid forms in Meriandra bengalensis, Stellate biradiate and Stellate triradiate in Colebrookia oppositifolia. Large variety of trichome types observed in 10 species are - Pogostemon pleotranthoides (16 types), Colebrookia oppositifolia (15 types), Leucas nepetaefolia and Leonotis nepetaefolia (14 types in each), Scutellaria grossa and Ocimum kilimandscharicum (13 types in each), Leucas urticaefolia and L. biflora (12 types in each), Thymus serpyllum and Leucas cephalotus (11 types in each) followed by Elsholtzia strobilifera, Micromeria biflora, M. capitellata, Calamintha umbrosa, Salvia plebeia, Leucas mollissima, L. stelligera, L. nutans, L. martinicensis, L. aspera

(10 types in each) Table - IX.

The genus Ocimum is one of the important group of herbaceous plants, yielding various essential oils used by the industry. Metcalfe & Chalk (1950) have reported only one type of foliar appendage in Ocimum, whereas, 3 types of foliar trichomes i.e. Uniseriate non-glandular, Multicellular Glandular with one celled head and many celled head have been described in Ocimum basilicum by Mathur (1961). Gupta and Bhambie (1978) studied 10 dermatypes of Ocimum and observed 16 type of trichomes. In present investigations 19 types of trichomes were observed, out of which 16 were Non-glandular & 3 Glandular. Among 16 Non-glandular types Uniseriate forms are most common and followed by Unicellular & Bicellular types. In O. kilimandscharicum, maximum number of trichome types (13 types) are observed, while lowest number of trichomes are recorded ⁱⁿ O. canum (6 types). All the considered 5 species of Ocimum i.e. O. basilicum, O. canum, O. gratissimum, O. sanctum and O. kilimandscharicum show quite resemblance to each other in having Uniseriate conical, Uniseriate hooked and Uniseriate glandular capitate hairs on different

parts. Further the presence Uniseriate conical and Unicellular glandular capitate type particularly on the calyx of all the 5 species provide an additional point of similarity in trichome distribution. Other trichome types are not so common and their distribution help in distinguishing these species. Q. kilimandscharicum shows maximum similarity, to Q. canum in having additional common types i.e. Unicellular papillose, Unicellular dentate, Bicellular hooked, and to Q. gratissimum in having additional common types of hairs i.e. Unicellular papillose, Bicellular conical and Bicellular hooked. Ocimum kilimandscharicum stands quite apart from remaining 4 species of Ocimum possessing 11 types of trichomes, particularly Bicellular glandular capitate on calyx and Peltate even on the corolla. Q. canum and Q. gratissimum can be distinguished from each other as former is the only species which does not possess any trichomes on the inflorescence axis, bract, corolla, stamen and gynoecium. Moreover, the presence of Uniseriate hooked and Unicellular glandular capitate on the stem and Unicellular hooked, Unicellular dentate, Bicellular hooked, alongwith Uniseriate conical, Uniseriate hooked and

Unicellular glandular capitate on the calyx separate O. canum from O. gratissimum, which exhibit Bicellular conical and Uniseriate conical on corolla and Bicellular conical on stamen. Remaining species i.e. O. basilicum is distinct in having Unicellular dentate, Bicellular curved, Bicellular belemnoid hairs and O. sanctum is distinct in having Unicellular papillose, Uniseriate aseptate flagellate, Peltate & Uniseriate glandular capitate. Besides the above O. sanctum is further distinguished from the rest in having Unicellular glandular capitate and Uniseriate glandular capitate hairs on the stamen.

Orthosiphon pallidus and O. rubicundus are found closer to each other in having Bicellular hooked, Uniseriate conical & Uniseriate hooked type and these could easily be separated from others on the basis of other trichome complements. The former species shows Bicellular hooked, Uniseriate filiform and Unicellular glandular capitate trichomes on gynoecium and the same types on corolla alongwith Unicellular papillose, whereas, the latter shows Bicellular cylindrical, Uniseriate curved and Peltate

on corolla.

The species of Plectranthus i.e. P. coetsa and P. mollis have total trichome types 5 and 7 respectively. The taxa shows resemblance in presence of Bicellular conical and Unicellular glandular capitate trichomes. The former species due to Bicellular conical, Uniseriate branched and Unicellular glandular capitate on calyx and Unicellular papillose and Uniseriate glandular capitate trichomes on corolla, can be separated from the latter in which Unicellular non-glandular forms are also lacking. Further, the presence of Peltate types on various parts including corolla alongwith Uniseriate conical types make P. mollis quite distinct from P. coetsa.

Taxa Anisochilus Carnosus, Hyptis suaveolens & Lavandula burmanni, are related to each other and to some other taxa as well, in having Unicellular glandular capitate hairs, but differ in the occurrence and distribution or absence of other forms. With the total absence of Unicellular forms A. carnosus differ from the rest two in having

Uniseriate hooked hairs on leaf margin & infl. axis. H. suaveolens in having Unicellular conical, Bicellular conical, Uniseriate filiform, Uniseriate conical, Unicellular glandular capitate & Uniseriate glandular capitate on calyx; Uniseriate aseptate flagellate, Unicellular glandular capitate & Uniseriate glandular capitate hairs on corolla stands distinct from L. burmanni in having Unicellular papillose, Unicellular conical, Unicellular hooked & Unicellular glandular capitate hairs on calyx; Unicellular conical & Unicellular torrulose on corolla (Table VIII). Thus the taxonomic distribution of particular trichomes become marker for the respective species.

Pogostemon plectranthoides bearing the maximum variety of trichome types among the studied taxa of Lamiaceae is observed similar to P. parviflorus in Unicellular papillose, Unicellular flagellate, Bicellular aseptate flagellate, Bicellular hooked, Unicellular glandular capitate and Uniseriate glandular capitate. These two can be distinguished, viewing the occurrence of various types on the corolla i.e. Unicellular flagellate. Bicellular

filiform, Uniseriate filiform, Uniseriate hooked & Uniseriate glandular capitate in the former whereas, Unicellular torrulose and Uniseriate acerate in the latter taxa.

Colebrookia oppositifolia bearing second largest variety of trichomes (15 types) among the studied taxa of Lamiaceae, reveals similarity from other in many forms. But the restricted occurrence of Stellate types (Stellate biradiate & Stellate triradiate) and interesting distribution of Unicellular papillose, Unicellular flagellate, Unicellular conical on the gynoeceum can prove the taxonomic identity of the trichome complex of this taxa.

Trichomes studies have revealed that Elsholtzia polystachya & E. strobilifera are quite similar in having Bicellular conical, Bicellular hooked, Uniseriate curved, Uniseriate acuminate & Unicellular glandular capitate hairs. These two can, however, be distinguished by the presence of Unicellular dentate & Uniseriate conical and specially Uniseriate branched in the former species and Unicellular conical, Uniseriate filiform, Uniseriate septate

flagellate, Uniseriate hooked and Peltate in the latter species of Elsholtzia.

Similarly Mentha arvensis & M. spicata bearing 6 & 5 types of trichomes are very close in the distribution of Peltate & Unicellular glandular capitate on the vegetative parts. The distribution of other forms particularly on floral parts provide a taxonomic importance of trichomic studies. From the floral parts of M. arvensis & M. spicata total 3 types (Unicellular papillose, Bicellular conical & Uniseriate conical.) and 4 types (Unicellular papillose, Bicellular hooked, Peltate & Unicellular glandular capitate) were recorded respectively. The distribution pattern of the particular trichome make them quite distinct from each other (Table VII & VIII).

Origanum vulgare and Thymus serpyllum are related to each other and to some other taxa as well in having Bicellular conical, Bicellular hooked, Uniseriate conical, Peltate & Unicellular glandular capitate; but differ from other forms. The former species is possessing Unicellular conical,

Unicellular curved, Uniseriate acuminate types and the latter Unicellular papillose, Unicellular torulose, Bicellular filiform, Bicellular septate flagellate, Uniseriate filiform & Uniseriate hooked ones.

Two species of Micromeria viz. M. biflora & M. capitellata sharing Unicellular hooked, Bicellular conical, Uniseriate conical, Unicellular glandular capitate common types, show marked differences in other hair forms. Beside the common trichome types the presence of Unicellular conical, Unicellular curved, Unicellular dentate, Bicellular curved, Uniseriate hooked & Uniseriate acerate in the former species, and Unicellular papillose, Bicellular hooked, Uniseriate curved, Uniseriate acuminate, Peltate & Uniseriate glandular capitate in the latter species, make it quite distinct.

The taxa calamintha umbrosa & Meriandra bengalensis; although are observed alike in possessing the Unicellular papillose, Bicellular conical, Unicellular glandular capitate & Uniseriate glandular capitate hairs, they show marked

differences in other form of hairs (Table VII & VIII). The former in bearing Bicellular hooked, Bicellular belemnoid, Uniseriate cylindrical, Uniseriate hooked, Peltate & Unicellular glandular capitate is quite distinct from the latter. M. bengalensis can further be separated due to the abundance of Uniseriate furcate & Dendroid forms on various parts. Moreover, floral distribution of hairs in these two taxa reveals remarkable trichomic identity i.e. 6 types (Table VIII) of trichomes are recorded on the corolla of C. umbrosa and only 1 type in M. bengalensis.

Metcalf and Chalk (1950) have reported the occurrence of only Glandular trichomes on the vegetative parts of the species of Salvia. Whereas, Singh et. al. (1974) reported 17 types (12 Non glandular and 5 of Glandular types) belonging to 4 major categories on the floral appendages. In the present study total 10 types belonging to 4 major Categories are recorded on the vegetative and floral parts of the 3 species of Salvia viz. S. coccinea, S. hians and S. plebeia.

The distribution of trichomes provide substantial criteria in distinguishing various species. The trichomes which are common to all the three species include Bicellular hooked, Uniseriate conical, Uniseriate curved, Uniseriate hooked, Unicellular glandular capitate, Bicellular glandular capitate from the Non glandular and Glandular categories respectively. The remaining forms are confined to one or two species. S. coccina shows presence of Uniseriate filiform type on the vegetative and floral parts and Unicellular papillose on stamens, while Uniseriate glandular capitate is recorded in S. hians and S. plebeia. These two S. hians and S. plebeia could also be easily separated on the basis of other trichome compliments. The former shows Bicellular conical on leaf margins & calyx, Uniseriate conical and Uniseriate glandular capitate on stamens, where as the latter has Bicellular curved and Uniseriate acuminate on different organs.

Species of Nepeta differ not only in the number of trichomes but also in qualitative characters. For examples N. connata bears 9 type of trichomes, out of

which 8-are Non glandular and 1-Glandular, while N. hindostana has 6-types (4 Non glandular & 2-Glandular). The former also shows distinctness in having Peltate hairs on the stamens. The N. tibetica bearing 5 Non glandular and all 3 Glandular categories, could easily be identified from the rest two species.

Although the taxa Scutellaria grossa, Anisomeles indica, Brunella vulgaris and Lamium album have been found similar in one or the other trichomes, yet they show marked differences in the distribution of similar and dissimilar form of hairs on the specific parts of the taxa proving taxonomic significance. For example, trichomes present on stamen: ~~viz~~ Unicellular papillose, Unicellular conical, Bicellular cylindrical, Bicellular glandular capitate and Uniseriate glandular capitate in S. grossa; Unicellular papillose & Uniseriate filiform in A. indica and only Unicellular flagellate in L. album put these three taxa quite significant from each other. B. vulgaris stands quite apart from former ones in lacking trichomes on the stamens. Further S. grossa is the only taxa among these which

possesses all three type of glandular trichomes (i.e. Unicellular glandular capitate, Bicellular glandular capitate, Uniseriate glandular capitate), on the corolla.

Twelve species of Leucas have been studied in present investigation. Bicellular hooked type is observed common to all whereas some trichomic forms are recorded in most of the species. For example Unicellular conical (except L. biflora) Uniseriate filiform (except L. urticaefolia) and Unicellular glandular capitate (except L. stelligera) have been found common to all 11 species. Bicellular conical, Uniseriate hooked, and bicellular glandular capitate are common in 8 species; Bicellular aseptate flagellate in 7 species; and Unicellular papillose, Bicellular filiform and Uniseriate curved in 6 species. Some hairs are rare in occurrence i.e. Unicellular acerate, Unicellular arrect in L. urticaefolia ; Unicellular acuminate in L. biflora. Bicellular septate flagellate in L. aspera and Uniseriate acerate in L. cephalotus, and thus provided taxonomic identity to these taxa. Other remaining species of Leucas which also share common

types may be separated on the basis of other trichome types and their specific organographic distribution. For example :- L. nepetaefolia, L. aspera and L. linifolia show presence of Uniseriate glandular capitate but L. nepetaefolia can be distinguished from the rest having this form only on the vegetative parts. Further L. linifolia get separated by the presence of Unicellular conical, Bicellular conical & Bicellular hooked hair on bract and Bicellular aseptate flagellate and Uniseriate aseptate flagellate along with Unicellular glandular capitate & Uniseriate glandular capitate on corolla.

Unicellular conical, Uniseriate filiform and Uniseriate hooked are the common form of trichomes and are Universally present in L. mollissima L. stelligera L. nutans L. martinicensis along with other nine types. L. stelligera may be separated from remaining three having Peltate type on the calyx. L. nutans is characterized by the presence of Unicellular papillose & Uniseriate filiform on corolla, Unicellular papillose on stamens and Unicellular glandular capitate on gynoecium. L. mollissima & L. martinicensis can also be separated from each other due to Bicellular acuminate &

Uniseriate conical in the former and Unicellular papillose & Bicellular aseptate flagellate in the latter species.

L. lanata having 9 types of trichomes appear very close to L. procumbens in having 8 types of trichomes common to both. Yet former can be distinguished from the latter having the presence of Bicellular filiform on petiole, leaves & calyx. Further L. procumbens stand quite distinguishable from L. lanata possessing Unicellular glandular capitate & Bicellular glandular capitate as additional types along with common Bicellular aseptate flagellate, Bicellular acuminate & Uniseriate filiform hairs. Thus the particular trichome becomes taxonomic marker for the respective species.

Leonotis nepetaefolia possessing 3rd highest number of hair types is quite identical to all the considered species in present investigation. The observation of largest variety of trichomes viz, Unicellular papillose, Bicellular aseptate flagellate, Bicellular cylindrical, Bicellular conical, Uniseriate filiform, Uniseriate aseptate

flagellate, Uniseriate acuminate and Unicellular glandular capitate types on corolla (Table VIII) gives a taxonomic identity.

Two species of Ajuga i.e. A. bracteosa & A. macrosperma are observed similar in Uniseriate hooked, Unicellular glandular capitate & Uniseriate glandular capitate types. The presence of Bicellular cylindrical, Bicellular conical, Uniseriate aseptate flagellate, Uniseriate conical help to distinguish the former from the latter, which is lacking Unicellular & Bicellular forms but bears Uniseriate filiform, Uniseriate septate flagellate & Uniseriate curved on vegetative as well as floral parts.

TABLE - VII

TOTAL TRICHOME TYPES OBSERVED IN THE FAMILY LAMIACEAE

S. NO.	TRICHOME TYPE	CODE
<u>Non-glandular Type</u>		
1	Unicellular papillose	A1
2	Unicellular flagellate	A2
3	Unicellular acerate	A3
4	Unicellular acuminate	A4
5	Unicellular conical	A5
6	Unicellular curved	A6
7	Unicellular hooked	A7
8	Unicellular dentate	A8
9	Unicellular torulose	A9
10	Unicellular arrect	A10
11	Bicellular filiform	B1
12	Bicellular aseptate flagellate	B2
13	Bicellular septate flagellate	B3
14	Bicellular cylindrical	B4
15	Bicellular conical	B5
16	Bicellular curved	B6
17	Bicellular hooked	B7
18	Bicellular acuminate	B8
19	Bicellular belemnoid	B9
20	Uniseriate filiform	C
21	Uniseriate aseptate flagellate	D
22	Uniseriate septate flagellate	E
23	Uniseriate cylindrical	F
24	Uniseriate conical	G
25	Uniseriate curved	H
26	Uniseriate hooked	I
27	Uniseriate acerate	J
28	Uniseriate acuminate	K
29	Uniseriate furcate	L
30	Uniseriate branched	M
31	Dendroid	P
32	Stellate biradiate	Q1
33	Stellate triradiate	Q2
34	Peltate	R
<u>Glandular Type</u>		
35	Unicellular glandular capitate	S
36	Bicellular glandular capitate	T
37	Uniseriate glandular capitate	U

TABLE - VIII
ORGANOGRAPHIC FREQUENCY IN : Σ DISTI
THE E

TAXA	STEM		COROLLA			
Ocimum basilicum	- B5	x x B G	x G	- S		
Ocimum canum	+ I	x S				
Ocimum gratissimum	+ S	- A	- B5	x G		
Ocimum sanctum	+ x D G	: :	x G	+ R	- U	
Ocimum kilimands- charicum			+ A1	+ C	+ E	x R
Orthosiphon pallidus	- A1	- - B B	x A1	- B7	x C	- S
Orthosiphon rubicundus	x A8	x R	- B4	+ H	x R	
Plectranthus coetsa	+ M	x S	- A1	- U		
Plectranthus mollis	x B5	++ G B	x G	x R		
Anisochilus carnosus	+ B5	+ - H B				
Hyptis suaveolens	+ H		x D	x S	+ U	
Lavandula burmanni	x A5	+ A	+ A5	+ A9		
Pogostemon parviflorus	x A1	+x B A - C	x A2	- B1	+ C	- I x U
Pogostemon plectran- thoides	- A5 - F	x- B A x J D	+ A9	- J		

CHAPTER V

GENERAL DISCUSSION.

GENERAL DISCUSSION

The family Verbenaceae is predominantly a tropical and sub tropical family, comprising about 98 genera and 2614 species. Where as Lamiaceae is a large family of about 200 genera and 3200 species of cosmopolitan distribution (Lawrence 1957). Though Verbena family is generally accepted as belonging within the "Tubiflorae" and of close affinity to the Lamiaceae. Bessey (1915) separated the Lamiaceae and Verbenaceae (on the basis of zygomorphic corolla and gynocial characters) as a distinct order, the Lamiales. Bentham and Hooker(1862-1883), Benson (1957), Takhtajan (1969), Cronquists (1968), Soo(1975), Dehlgren(1980) placed these families (Verbenaceae and Lamiaceae) in order Lamiales. Hallier (1905), Rendle (1925), Wettstein (1935) followed the Englarian's view that these families belong to the "Tubiflorae". Hutchinson (1926) did likewise at first but in 1948 he changed his classification and placed these families under a separate division i.e. Lignosae- Verbenales - Verbenaceae; Herbaceae - Lamiales - Lamiaceae. Recently in 1980 a new version of Takhtajan's

classification has been published in which he separated Verbenaceae from Lamiales and placed it in the next order Scrophulariales.

Hooker (1885) classified the family Verbenaceae and Lamiaceae into six and seven tribes respectively in his "Flora of British India" and some of the tribes of Lamiaceae were further subdivided into subtribes.

The family Verbenaceae shows close relationship with Lamiaceae in bilabiate corolla, persistent calyx, inferior micropyle of the ovule. But the former family is distinguished from latter by the usually non-verticillate inflorescence, terminal style and undivided ovary. Further the sub-family Ajugoideae and Prostantheroideae of Lamiaceae resemble the Verbenaceae in that the style is terminal not gynobasic as in other mints; Likewise several Verbenaceous genera have a nearly gynobasic style. The presence of these and other intergrading characters makes it difficult, if not impossible, to separate all members of one family from the other by any single characters or combination of characters and in most reliable keys artificial characters are

used (Lawrence 1951).

Hooker (1885) recognized 23 genera in *Verbenaceae*, whereas Maheshwari (1963) recognized 16 genera, Haines (1922) 17 genera, Duthie (1960) 11 genera, Prain (1963) 17 genera, Saldanha & Nicolson (1976) 11 genera, Oommachan (1977) 12 genera. Similarly in *Lamiaceae*, Hooker (1885) included 55 genera, Haines (1922) 25 genera, Duthie (1960) 24 genera, Prain (1963) 26 genera, Saldanha & Nicolson (1976) 19 genera, Maheshwari (1963) 8 genera and Oommachan (1977) 13 genera. In the present investigation 35 species belonging to 15 genera of *Verbenaceae* and 50 species belonging to 24 genera of *Lamiaceae* are considered for trichomic exploration to evaluate the taxonomic significance.

During the last century considerable interest seems to have been created in the study of plant trichomes and recently extensive work has been done on different aspects of trichomes in many families. However these two families i.e. *Verbenaceae* & *Lamiaceae*, barring a few publications on trichome morphology and their classification, much work has

not been done.

The taxonomic value of trichomes are of special relevance in *Verbenaceae* & *Lamiaceae*, because of their wide distribution in almost all sorts of environmental condition. The observations about trichome structure and their organographic distribution as taxonomic marker are mostly fragmentary. (El-Gazzaar 1974, Ramayya 1977, Shah & Methew 1982b, Kaushal & Tripathi 1984).

Metcalf & Chalk (1950) reported 5-types of Non glandular and 2-types of Glandular trichomes in *Verbenaceae*. He further divided Non glandular hairs into 8-types, depending upon the number of cells and their shape. Among Glandular hairs categories were made considering small head consisting of one to few cells borne on stalk of variable length and short stalked, disk-shaped multicellular glands. For the family *Lamiaceae* he reported that "Hairs are variable but offering valuable characters for the identification of genera and species. The occurrence together of diverse kinds of clothing hairs and characteristic, short stalked glands is characteristic of the whole family". He recorded

three major types of Non-glandular hairs having Bicellular, Uniseriate and Branched or Tufted multicellular structure. Several forms of first two types are also mentioned by hairs. Under Glandular categories, he reported 6-types considering number of head and stalk cells viz.

- (a) Head Unicellular, stalk upto 3 cells long.
- (b) Head Bicellular, shortly stalked.
- (c) Head four celled, stalk short.
- (d) Head eight celled, stalk usually very short, frequently sink in pits.
- (e) Head eight celled with longer stalk.
- (f) Head sixteen or more celled stalk short or long (relatively infrequent)

In the present study of 85 species belonging to 39 genera of two families i.e. Verbenaceae and Lamiaceae, total 42-type of trichomes have been observed. Among these 7-Unicellular i.e. A2, A3, A4, A6, A7, A8, A9 and 5-Uniseriate forms i.e. E, G, K, L, N in Non glandular category and "V" type in Glandular category in the Verbenaceae and 5-Bicellular types i.e. B4, B5, B6, B7, B9 and 3-Uniseriate forms i.e. D, F, K in Lamiaceae are newly

established in the present work. Occurrence of Bicellular forms in *Verbenaceae* and Unicellular form in *Lamiaceae* is an important feature as they have not been reported by Metcalfe & Chalk (1950). However the Glandular forms observed in present study agree with the observation of Metcalfe & Chalk (1950). It may be pointed out that some of the trichome types described in literature seem to be trichome complex rather than specific types. In present study such forms are considered to represent different trichome types. This approach is strengthened by the observation that certain forms have different organographic distribution. (Table-IV & VIII). Out of 42 - type of trichomes 38 forms were recorded in the *Verbenaceae* and 37 - form in *Lamiaceae*. All these forms may be divided into two major categories i.e. Non glandular and Glandular. (Table XII)

The Non glandular trichomes as shown in table XII are divided into Unicellular, Bicellular and Multicellular types, depending upon the number of cells forming the body of trichome. The Multicellular types are further distinguished into Uniseriate, Dendroid, Stellate and Peltate forms. Unicellular trichomes are further classified into 11 - categories

(viz, papillose, flagellate, acerate, acuminate, conical, curved, hooked, dentate, torrulose, arrect, dolebrate) on the basis of the final form of the trichome.

Bicellular hairs are not so common as Unicellular ones, they are of 9-types (viz. filiform, aseptate flagellate, septate flagellate, cylindrical, conical, curved, hooked, acuminate & belemnoid). Similarly Uniseriate forms are further classified into 13-types (viz., filiform, aseptate flagellate, septate flagellate, cylindrical, conical, curved, hooked, acerate, acuminate, furcate, branched, torrulose, falcate). Stellate types are divided into Stellate bi, tri, or multiradiate forms. Whereas, Dendroid & Peltate type have only one type in each category. Glandular form are divided into 4-types (viz., Unicellular glandular capitate, Bicellular glandular capitate, Uniseriate glandular capitate & Dendroid glandular capitate).

The classification of observed trichome type is given in the table XII and the distribution of total trichomes observed in two families are shown below :

Trichome category	Verbenaceae	Lamiaceae
<hr/>		
Non glandular	34	34
Glandular	4	3

The above distribution of Non glandular and Glandular trichome analysis clearly reveals that Non glandular types of hairs are more in occurrence than the Glandular ones.

A particular family can be distinguished on the basis of presence/ absence of particular type of hairs. Unicellular hairs are the common forms and frequently distributed on all the parts of taxa in both the families, except Unicellular arrect trichomes in *Verbenaceae* and Unicellular dolebrate in *Lamiaceae*.

Both *Verbenaceae* & *Lamiaceae* exhibit similarity in majority of trichome types (viz., 9-Unicellular : A1, A2, A3, A4, A5, A6, A7, A8, A9; 7-Bicellular : B1, B2, B4, B5, B6, B7, B9; 14-Multicellular including

A Comparative data presenting the similarity in the number of trichome types recorded on vegetative & floral parts is given below.

S.NO.	Plant part	Number of trichome	
		Verbenaceae	Lamiaceae
1.	Stem	31	29
2.	Petiole	27	24
3.	Leaf upper surface	31	26
4.	Leaf lower	32	30
5.	Leaf margin	24	30
6.	Infl.axis	29	25
7.	Bract	24	28
8.	Calyx	33	33
9.	Corolla	26	29
10.	Stamen	13	09
11.	Gynoecium.	06	06

Analysis of the trichome complement studies at family level reveals that some hairs may be present on the vegetative as well as floral parts or only on

the vegetative or floral parts. In Verbenaceae F & J types are recorded on vegetative parts only & A9 on floral parts only, whereas, in Lamiaceae Q2 on vegetative & A4, A9 on floral parts only. Beside the common occurrence of trichome type, a restricted occurrence provides a taxonomic identification. It becomes much significant when they are restricted to a particular organ specially floral parts.

It has already been established that hairs often play very significant role in taxonomic consideration, as they show very wide range of variation in their shape, size and hair base structure within a genus. But when they are of a characteristic form they can serve as a means of distinction among the species.

From the foregoing observation it is clear that A11, J, K, O, Q2 and A3, A4, A6, P, Q1 & Q2 types of trichomes containing taxa are few in Verbenaceae and Lamiaceae respectively.

In the family Verbenaceae hairs restricted in distribution are Unicellular dolebrate in taxa Lippia nodiflora, Uniseriate acerate in Holmskioldia sanguinea, Uniseriate acuminate in Premna wightiana,

Uniseriate falcate in Durenta plumieri and stellate triradiate in callicarpa lanata. Similarly in Lamiaceae Unicellular acerate in Leucas urticaefolia, Unicellular acuminate in L. biflora, Unicellular curved in Micromeria biflora, Dendroid in Meriandra bengalensis and Stellate bi & triradiate types in Colebrookia oppositifolia

A number of excellent studies on various plant groups have attested the systematic importance of trichomes particularly when they are present on floral parts. Verbenaceae and Lamiaceae provide an interesting data about the floral parts having maximum variety of trichomes (33 - types) than vegetative parts. In consideration of all the four floral whorls, particularly stamen and Gynoecium, the different taxa become quite identical from others, bearing a particular trichome complex on these organs. In the Verbenaceae A1, A2, A5, B1, B4, B5, B9, E, G, R, S, T, U on stamen of 12-taxa, P, Q2, R, T, U, types on Gynoecium of 7-taxa, were recorded, whereas in Lamiaceae A1, A2, B1, B5, B7, C, R, S, U on the stamen of 14-taxa and A1, A2, A5, B7, C, S on Gynoecium of 3-taxa were observed.

Thus sixteen taxa of both Verbenaceae i.e. OTU's 2, 6, 11, 12, 15, 17, 18, 19, 20, 21, 23, 26, 28, 29, 30 & 34 and Lamiaceae i.e. 3, 4, 6, 15, 19, 21, 26, 27, 29, 32, 34, 35, 41, 43, 48 & 49 stand quite significant from remaining considered taxa of their respective family possessing characteristic trichome types either on Stamen and Gynoecium or on Stamen or Gynoecium only. On the other hand common presence of maximum types of trichomes on the floral parts of the taxa of these two families further enhance the very close similarity in between them.

The overall, outcome of the present investigations support the view of Bentham & Hooker (1950) who placed these two families very close to each other in their classification. However, some sort of distance on the basis of trichomic distinctions is suggested and as such the family Verbenaceae is placed under order Verbenales and Lamiaceae under Lamiales.

In present study an attempt is made to draw trichomic affinities in-between Verbenaceae & Lamiaceae. Present fruitful investigation stress a need to undertake detailed studies involving larger

number of species under each of the family from the view of trichome structure and distribution. Thus the results of the present taxonomic study on trichomes of the taxa of Verbenaceae and Lamiaceae is a contribution towards the goal of achieving this objective.

Some noteworthy observation are given in Summary and Conclusion. On the basis of types of trichomes and their distribution a Key has also been devised to distinguish various taxa of the family Verbenaceae and Lamiaceae investigated and is given in appendix I & II.

TABLE - XI
 RECORD OF TRICHOME TYPES AND THEIR PERCENTAGE OCCURANCE IN THE TAXA
 OF FAMILY VERBENACEAE & LAMIACEAE

TRICHOME TYPE	CODE	VERBENACEAE			LAMIACEAE		
		PRES- ENCE	NO. OF TAXA	%	PRES- ENCE	NO. OF TAXA	%
Non-glandular type							
Unicellular papillose	A1	+	17	48.6	+	28	56
Unicellular flagellate	A2	+	11	31.4	+	8	16
Unicellular acerate	A3	+	4	11.4	+	1	2
Unicellular acuminate	A4	+	3	8.6	+	1	2
Unicellular conical	A5	+	17	48.6	+	24	48
Unicellular curved	A6	+	8	22.9	+	1	2
Unicellular hooked	A7	+	15	42.9	+	8	16
Unicellular dentate	A8	+	4	11.4	+	10	20
Unicellular torulose	A9	+	2	5.7	+	2	4
Unicellular arrect	A10	-	-	-	+	3	6
Unicellular dolebrate	A11	+	1	2.9	-	-	-
Bicellular filiform	B1	+	6	17.1	+	9	18
Bicellular aseptate flage.	B2	+	8	22.9	+	13	26
Bicellular septate flage.	B3	-	-	-	+	2	4
Bicellular cylindrical	B4	+	7	20.0	+	8	16
Bicellular conical	B5	+	12	34.3	+	37	74
Bicellular curved	B6	+	5	14.3	+	2	4
Bicellular hooked	B7	+	16	45.7	+	34	68
Bicellular acuminate	B8	-	-	-	+	6	12
Bicellular belemnoid	B9	+	2	5.7	+	3	6
Uniseriate filiform	C	+	8	22.9	+	25	50
Uniseriate aseptate flage.	D	+	6	17.1	+	5	10
Uniseriate septate flage.	E	+	11	31.4	+	9	18
Uniseriate cylindrical	F	+	2	5.7	+	5	10
Uniseriate conical	G	+	8	22.9	+	25	50
Uniseriate curved	H	+	10	28.6	+	22	44
Uniseriate hooked	I	+	16	45.7	+	34	68
Uniseriate acerate	J	+	1	2.9	+	5	10
Uniseriate acuminate	K	+	1	2.9	+	7	14
Uniseriate furcate	L	+	7	20.0	+	2	4
Uniseriate branched	M	+	2	5.7	+	3	6
Uniseriate torulose	N	+	2	5.7	-	-	-
Uniseriate falcate	O	+	1	2.9	-	-	-
Dendroid	P	+	3	8.6	+	1	2
Stellate biradiate	Q1	-	-	-	+	1	2
Stellate triradiate	Q2	+	1	2.9	+	1	2
Stellate multiradiate	Q3	+	2	5.7	-	-	-
Peltate	R	+	19	54.3	+	15	30
Glandular Type							
Unicellular glandular capi.	S	+	26	74.3	+	47	94
Bicellular glandular capi.	T	+	16	45.7	+	20	40
Uniseriate glandular capi.	U	+	15	42.9	+	20	40
Dendroid glandular capi.	V	+	2	5.7	-	-	-

(+) for Presence & (-) for Absence.

TABLE - XII

CLASSIFICATION OF TRICHOMES OBSERVED IN FAMILY
VERBENACEAE & LAMIACEAE

A. NON-GLANDULAR TRICHOMES

Unicellular	Bicellular	Multicellular
<ul style="list-style-type: none"> - papillose - flagellate - acerate - acuminate - conical - curved - hooked - dentate - torrulose - arrect - dolebrate 	<ul style="list-style-type: none"> - filiform - aseptate flagellate - septate flagellate - cylindrical - conical - curved - hooked - acuminate - belemnoid 	

Uniseriate	Dendroid	Stellate	Peltate
<ul style="list-style-type: none"> - filiform - aseptate flagellate - septate flagellate - cylindrical - conical - curved - hooked - acerate - acuminate - furcate - branched - torrulose - falcate 		<ul style="list-style-type: none"> - biradiate - triradiate - multiradiate 	

B. GLANDULAR TRICHOMES

Unicellular	Bicellular	Uniseriate	Dendroid
<ul style="list-style-type: none"> - glandular capitate 	<ul style="list-style-type: none"> - glandular capitate 	<ul style="list-style-type: none"> - glandular capitate 	<ul style="list-style-type: none"> - glandular capitate

CHAPTER VI

SUMMARY AND CONCLUSION.

CHAPTER - VI

SUMMARY & CONCLUSIONS

The present study is based on 85 species belong to 39 genera representing two families viz, 15 genera and 35 species from Verbenaceae and 24 genera and 50 species from Lamiaceae.

Verbenaceae is a large tropical and subtropical family comprising about 98 genera and 2614 species. Whereas in Lamiaceae 200 genera and 3200 species represented cosmopolitan distribution (Lawrence 1951). In India the family Verbenaceae and Lamiaceae are represented by 23 and 55 genera respectively (Hooker 1885).

These two families are not only important from the point of view of wild taxa which show great variation in morphological characters but also due to interesting medicinal, timber and ornamental plants.

Recently trichomes and their morphological

variation have been found to be an important tool in dealing with taxonomic problems and interrelationships of taxa. The families included in the present studies are known to be having great variety of trichomes. However work reported so far on the trichomes of these families is quite scanty.

Hence the present studies on structure, Organographic distribution of vegetative as well as floral trichomes were taken in hand and the extent to which the result can be used in solving taxonomic problems within these families has been assessed.

A total number of 42 type of trichomes are recorded. All of these form of hairs have been grouped into two main categories i.e., Non glandular (38 types) and Glandular (4 types). The Non glandular trichomes are divided into Unicellular (11 types), Bicellular (9 types) and Multicellular (depending upon the number of cells forming the body of trichome). The last category of hairs (Multicellular) further distinguished into Uniseriate (13 types), Stellate (3 types), Peltate and Dendroid types.

The Glandular trichomes are classified into Unicellular glandular capitate, Bicellular glandular capitate, Uniseriate glandular capitate and Dendroid glandular capitate.

An occurrence of total trichome types in these families is given below :

Trichome category	Verbenaceae	Lamiaceae
Non glandular trichomes	34	34
Glandular trichomes	4	3

The above trichome analysis clearly reveals that Non glandular hairs are more common in occurrence than the Glandular ones. Further, the considered two families are much similar in their trichome Complexes.

The following conclusions based on the results of present study reveals taxonomic significance of trichomes in Verbenaceae and Lamiaceae.

1. Among Non glandular category an observation of Bicellular form in Verbenaceae and Unicellular form

in Lamiaceae are most important because they were not reported by Metcalfe and Chalk (1950). Further 7 - forms in Unicellular types i.e. A2, A3, A4, A6, A7, A8, & A9; 5 - forms in Uniseriate types i.e. E, G, K, L, N; in the Verbenaceae and 5 - forms in Bicellular types i.e. B4, B5, B6, B7, B9; 3 - forms in Uniseriate types i.e. D, F, K in the family Lamiaceae are newly recorded.

2. In Glandular category, Dendroid glandular capitate type is the new record in the Verbenaceae and it is observed on the leaf upper surface of Callicarpa lanata and on the leaf lower surface & corolla of Tectona grandis.
3. Both Verbenaceae and Lamiaceae exhibit similarity in most of the trichome types (a) presence of 9 - Unicellular forms i.e. A1, A2, A3, A4, A5, A6, A7, A8, A9; (b) presence of 7 - Bicellular i.e. B1, B2, B4, B5, B6, B7, B9; (c) presence of 14 - Multicellular i.e. C, D, E, F, G, H, I, J, K, L, M, P, Q2, R and (d) presence of 3 - Glandular types i.e. S, T, U.

4. The considered families shows heterogeneity in some trichomic form i.e. the family Verbenaceae lacking Unicellular arrect, Bicellular septate flagellate, Bicellular acuminate & Stellate biradiate and in Lamiaceae absence of Unicellular dolebrate, Uniseriate torrulose, Uniseriate falcate, Stellate multiradiate and Dendroid glandular capitate types.
5. In the Non glandular category Unicellular hairs are most common and are observed on all the parts of the studied taxa except stamen & gynoecium where they are restricted in occurrence. Viz., only A1, A2 & A5 types on stamens and A2 type on gynoecium are observed in Verbenaceae. Similarly A1 & A2 types on stamens and A1, A2 & A5 on gynoecium are recorded in the Lamiaceae. Among Unicellular category Papillose type is represented by maximum number of taxa of Verbenaceae and Lamiaceae (17 & 28 species respectively). Some of the Unicellular forms are rather restricted in distribution and each observed in one species only. Such as Unicellular dolebrate in Lippia nodiflora of Verbenaceae whereas Unicellular acerate in Leucas urticaefolia, Unicellular acuminate in Leucas biflora and Unicellular curved in

Micromeria biflora of Lamiaceae.

6. Bicellular conical and bicellular hooked appeared comparatively common, being present on 36 & 34 taxa of Lamiaceae and 12 & 16 taxa of Verbenaceae .

7. Out of 18 - Multicellular trichome types, 14 - types are recorded in Verbenaceae, in which Peltate type is recorded in maximum number (19 species) followed by Uniseriate hooked (16 species). In Lamiaceae 15 types of Multicellular trichomes are recorded. Among these Uniseriate hooked is observed in 34 species, followed by Uniseriate filiform & Uniseriate conical types each in 25 species. Some of the Multicellular forms are restricted in distribution and each observed in one species only.i.e., Uniseriate acerate in Holmskioldia sanguinea, Uniseriate acuminate in Premna wightiana , Uniseriate falcate in Durenta plumeiri and Stellate triradiate in Callicarpa lanata of Verbenaceae. In Lamiaceae, Dendroid types in Meriandra bengalensis and Stellate biradiate & triradiate types in Colebrookia oppositifolia are restricted in occurrence.

8. Total four types of Glandular hairs have been observed in present investigation and all the type are recorded in family Verbenaceae. While, in Lamiaceae, Dendroid glandular capitate type is not observed.
9. Among Glandular category, Unicellular glandular capitate is one of the most common type, occurring frequently on the various parts of 47 -taxa of Lamiaceae and 26 - taxa of Verbenaceae. Metcalfe & Chalk (1950) have also observed it in Lamiaceae as a characteristic type of the whole family.
10. Range of number of trichome types observed in Lamiaceae is as follow : Pogostemon plectranthoides - 16 types; Colebrookia oppositifolia - 15 types; Leucas nepetaefolia and Leonotis nepetaefolia - 14 types in each. Similarly in Premna latifolia & Holmskioldia sanguinea - 14 types in each, Vitex negundo and Clerodendron phlomoides - 13 types in each; Verbena bipinnatifida and Vitex siamica - 12 types in each are observed in family Verbenaceae.

11. Trichome complements studies at family level reveals that most of the trichomes are recorded on both Vegetative and floral parts. Some types are restricted either to vegetative or to floral parts. Such as in Verbenaceae Uniseriate cylindrical and Uniseriate acerate types are observed on vegetative parts only and Unicellular torrulose on floral parts only. In Lamiaceae Stellate triradiate are recorded on vegetative and Unicellular acuminate & Unicellular torrulose on floral parts only.
12. In Verbenaceae A1, A2, A5, B1, B4, B5, B9, E, G, R, S, T, & U types of trichomes on stamen of 12 -taxa and P, Q2, R, T & U types on the gynoecium of 7 -taxa are recorded; whereas in Lamiaceae A1, A2, B1, B5, B7, C, R, S & U on the stamen of 14 - taxa and A1, A2, A5, B7, C & S on gynoecium of 3 taxa are recorded. The aforesaid types being present in various reticulate combinations in different taxa attested the systematic importance of themselves in present investigation.
13. Lippia nodiflora, Durenta plumieri, prema wightiana, Holmskioldia sanguinea, Callicarpa lanata

are quite distinct in possessing specific form of trichomes in each e.g. Unicellular dolebrate, Uniseriate falcate, Uniseriate acuminate Uniseriate acerate and Stellate triradiate respectively. Similarly Colebrookia oppositifolia, Micromeria biflora, Leucas urticaefolia, L.biflora and Meriandra bengalensis in Lamiaceae are distinct from the considered taxa in possessing Stellate bi and tri radiate, Unicellular curved, Unicellular acerate Unicellular acuminate and Dendroid forms respectively.

14. In family Verbenaceae - Lantana camara, L.indica, Lippia ~~geminata~~, L.nodiflora, Verbena bonariensis are the species which lack Bicellular and Multicellular type of trichomes. Presence of only Peltate and Unicellular type of trichomes on all the parts of Verbena officinalis prove taxonomic value of trichomes. Another interesting observations occurred in Nyctanthes arbortristis where no Glandular forms are observed. Similarly Clerodendron indicum being absolutely glabrous, could also be identified on occurrence of only Peltate and Unicellular glandular capitate types.

15. Trichomic key devised to identify the taxa of Verbenaceae and Lamiaceae successfully support the view of earlier workers regarding taxonomic importance of plant hairs.
16. Trichomic similarity at trichomic level reveals that the family Verbenaceae and Lamiaceae are stand together at 82% similarity in Unicellular forms, 78% both in Bicellular and Multicellular forms and 75% in Glandular forms. At Overall trichome level these families exhibit 79% similarity.

TRICHOME KEY TO THE TAXA OF FAMILY VERBENACEAE

1. Unicellular glandular capitate present.
2. Bicellular glandular capitate present.
3. Unicellular hooked present.
4. Unicellular torrulose present Premna latifolia
4. Unicellular torrulose absent.
5. Uniseriate cylindrical present Stachytarpheta indica
5. Uniseriate cylindrical absent.
6. Unicellular flagillate present.
7. Unicellular & Glandular on infl.axis present Lantana indica
7. Unicellular & Glandular on infl.axis absent Lippia geminata.
6. Unicellular flagillate absent Verbena bonariensis.
3. Unicellular hooked absent.
8. Peltate present.
9. Uniseriate glandular capitate present.
10. Uniseriate furcate present Clerodendron splendens
10. Uniseriate furcate absent C. multiriorum
9. Uniseriate glandu. capitate absent Carvopteris wallichiana
8. peltate absent.
11. Uniseriate curved present Premna wightiana
11. Uniseriate curved absent Gmelina arborea
2. Bicellular glandular capitate absent.
12. Uniseriate glandular capitate present.
13. Peltate present.
14. Uniseriate furcate present.
15. Uniseriate aseptate flagellate present.
16. Bicellular curved present Clerodendron phlomidis
16. Bicellular curved absent Holmskioldia sanguinea
15. Uniseriate aseptate flagellate absent Verbena bipinnatifida
14. Uniseriate furcate absent.
17. Multi-radiate type present Callicarpa macrophylla
17. Multi-radiate type absent Gmelina philipensis
13. Peltate absent.
18. Dendroid present Callicarpa lanata
18. Dendroid absent.
19. Uniseriate sept. flagellate present Vitex agnus castus
19. Uniseriate sept. flagellate absent.
20. Unicellular forms present Lantana camara
20. Unicellular forms absent Clerodendron serratum
12. Uniseriate glandular capitate absent.
21. Unicellular dolebrate present Lippia nodiflora
21. Unicellular dolebrate absent.
22. Uniseriate sept. flagellate present Vitex negundo
22. Uniseriate sept. flagellate absent.
23. Uniseriate conical present.
24. Bicellular filiform present Clerodendron multizuga
24. Bicellular filiform absent Clerodendron fragrans
23. Uniseriate conical absent.
25. Uniseriate hooked & curved present Clerodendron inerme
25. Uniseriate hooked present Clerodendron peniculatur
25. Peltate & Unic. glandu. capi. trichome present Clerodendron indicum

(Contd...)

1. Unicellular glandular capitate absent.	.....	<i>Tectona grandis</i>
26. Peltate present.	.....	<i>Duranta plumieri</i>
27. Bicellular glandular capitate present.	.....	<i>Petrea volubilis</i>
28 Unis. glandu. capitate present.	.....
29. Dendroid forms present	.....	<i>Vitex siamensis</i>
29. Dendroid forms absent.	.....	<i>Clerodendron infortunatum</i>
30. Uniseriate falcate present.	.....
30. Uniseriate f. leatis absent; conical present.	.....	<i>Vitex coriacea</i>
28. Uniseriate glandular capitate absent.	.....	<i>Verbena officinalis</i>
31. Unis. sept. flagellate present.	.....
31. Unis sept. flagellate absent.	.....	<i>Callicarpa tomentosa</i>
27. Bic. glandu. cap. absent.	.....	<i>Nyctanthes arborescens</i>
32 Uniseriate torulose present.	.....
32. Uniseriate torulose absent.	.....
26. Peltate absent.	.....
33. Dendroid forms present.	.....
33. Dendroid forms absent & Uniseriate torulose on leaf lower surface.	.....

Appendix - II

TRICHOME KEY OF THE TAXA OF FAMILY LAMIACEAE

1. Unicellular glandular capitate present.
2. Bicellular glandular capitate present.
3. Uniseriate glandular capitate present.
4. Uniseriate hooked present. *Calamintha umbrosa*
5. Peltate present. *Leucas nepetaefolia*
5. Peltate absent.
6. Uniseriate aseptate flagellate present. *L. aspera*
6. Uniseriate aseptate flagellate absent.
7. Uniseriate filiform present. *Nepeta tibetica*
8. Bicellular septate flagellate present. *Salvia plebeia*
8. Bicellular septate flagellate absent. *S. hians*
7. Uniseriate filiform absent.
9. Uniseriate acuminate present. *Colebrookia oppositifolia*
9. Uniseriate acuminate absent. *Pogostemon plectranthoides*
4. Uniseriate hooked absent.
10. Uniseriate branched present. *Scutellaria grossa*
10. Uniseriate branched absent.
11. Bicellular conical present. *Leonotis nepetaefolia*
11. Bicellular conical absent. *Ocimum kilimandscharicum*
3. Uniseriate glandular capitate absent.
12. Peltate present.
13. Uniseriate acuminate present. *Leucas urticaefolia*
13. Uniseriate acuminate absent. *L. mollissima*
12. Peltate absent.
14. Uniseriate conical present. *Salvia coccinia*
15. Bicellular acuminate present. *Leucas martinicensis*
16. Unicellular papillose present. *Leucas lanata*
16. Unicellular papillose absent. *L. procumbens*
15. Bicellular acuminate absent.
14. Uniseriate conical absent.
17. Uniseriate hooked present. *Ocimum sanctum*
17. Uniseriate hooked absent. *Micromeria capitellata*
18. Bicellular filiform present. *Plectranthus coetse*
18. Bicellular filiform absent.
2. Bicellular glandular capitate absent.
19. Uniseriate glandular capitate present.
20. Peltate present.
21. Uniseriate aseptate flagellate present. *Ajuga macrosperma*
21. Uniseriate aseptate flagellate absent. *A. bractiosa*
20. Peltate absent.
22. Uniseriate branched present.
22. Uniseriate branched absent.
23. Uniseriate hooked present.
24. Uniseriate conical present.
24. Uniseriate conical absent.
25. Uniseriate aseptate flagellate present.
25. Uniseriate aseptate flagellate absent.

- 26. Bicellular filiform present.....*Pogostemon parviflorus*
- 26. Bicellular filiform absent.....*Anisomeles indica*
- 23. Uniseriate hooked absent.
- 27. Uniseriate curved present.....*Hyptis suaveolens*
- 27. Uniseriate curved absent.
- 28. Dendroid present.....*Meriandra bengalensis*
- 28. Dendroid absent.....*Leucas linifolia*
- 19. Uniseriate glandular capitate absent.
- 29. Peltate absent.
- 30. Uniseriate hooked present.
- 31. Uniseriate conical present.
- 32. Uniseriate filiform present.....*Thymus serpyllum*
- 32. Uniseriate filiform absent.....*Plectranthus coetosa*
- 31. Uniseriate conical absent.
- 33. Uniseriate septate flagellate present.
- 34. Uniseriate cylindrical present.....*Nepeta connata*
- 34. Uniseriate cylindrical absent.....*Elsholtzia strobilifera*
- 33. Uniseriate septate flagellate absent.....*Mentha spicata*
- 30. Uniseriate hooked absent.
- 35. Uniseriate acerate present.....*Leucas cephalotus*
- 35. Uniseriate acerate absent.
- 36. Bicellular hooked present.....*Origanum vulgare*
- 36. Bicellular hooked absent.....*Mentha arvensis*
- 29. Peltate absent.
- 37. Uniseriate hooked present.
- 38. Bicellular belemnoid present.....*Ocimum basilicum*
- 38. Bicellular belemnoid absent.
- 39. Uniseriate conical present.
- 40. Unis. filiform present.
- 41. Bicellular cylindrical present.....*Leucas biflora*
- 41. Bicellular absent.....*Orthosiphon pallidus*
- 40. Unis. filiform absent.
- 42. Bicellular curved present.....*Micromeria biflora*
- 42. Bicellular curved absent.
- 43. Unicellular hooked present.....*Ocimum gratissimum*
- 43. Unicellular hooked absent.
- 44. Bicellular conical present.
- 45. Uniseriate dentate present.....*Brunella vulgaris*
- 45. Uniseriate dentate absent.....*Anisochilus carnosus*
- 44. Bicellular conical absent.....*Ocimum canum*
- 39. Uniseriate conical absent.
- 46. Uniseriate cylindrical present.....*Leucas nutans*
- 46. Uniseriate cylindrical absent.....*Lamium album*
- 37. Uniseriate hooked absent.
- 47. Uniseriate branched present.....*Elsholtzia polystachya*
- 47. Uniseriate branched absent.....*Lavandula burmanni*
- 1. Unicellular glandular capitate absent.
- Bicellular glandular capitate present.
- 48. Uniseriate glandular capitate present.....*Nepeta hindostana*
- 48. Uniseriate glandular capitate absent.
- 49. Uniseriate septate flagellate present.....*Leucas stelligera*
- 49. Uniseriate septate flagellate absent.....*Orthosiphon rubicundus*

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